TOWARD A COMMON FUTURE

A REPORT ON SUSTAINABLE DEVELOPMENT AND ITS IMPLICATIONS FOR CANADA

MICHAEL KEATING

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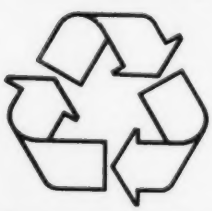

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MICHAEL KEATING

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INTRODUCTION

"The world is facing an environmental crisis of unparalleled magnitude. Nature is sending us an urgent message that we ignore at our peril. The signs of this crisis are all around us: shortages of timber, exhausted soil, desertification, depleted fish stocks, seals dying in the North Sea, beluga whales washing ashore in the St. Lawrence River. Some even maintain that we have reached a point where the survival of mankind is at risk."

– Prime Minister Brian Mulroney speaking to the General Assembly of the United Nations on September 29, 1988.

"Our era has been one of unbridled, even aggressive, development. This must now be replaced by prudence, self-discipline and respect for the natural environment."

– Environment Minister Lucien Bouchard speaking to a conference on global climate change, New York, March 2, 1989.

In the last few years the deteriorating state of the environment has become front-page news. We are bombarded with a daily litany of old problems getting worse and new ones being discovered.

Environmental degradation, including the spread of harmful chemicals, climate change, the destruction of forests, farmlands, waters and the ozone layer is being recognized as one of the greatest challenges to civilization.

In its 1987 report on the future of the planet, the World Commission on Environment and Development said the threat of environmental destruction is second only to that of nuclear war. The commission, headed by Norwegian Prime Minister Gro Harlem Brundtland, said that environmental damage in parts of the earth is already worse than scorched earth policies of armies.

The Brundtland Report, *Our Common Future,* dismisses the idea that this kind of destruction can continue. "Nature is bountiful but it is also fragile and finely balanced," says the report. "There are thresholds that cannot be crossed without endangering the basic integrity of the system. Today we are close to many of those thresholds."

The United Nations-sponsored Brundtland Commission did not call for an economic shutdown to protect the environment. That would be impossible in the industrialized world and unfair to the developing world, where many are just beginning to enjoy the fruits of modern technology.

Instead, the global commission issued a new agenda, saying the planet needs what it termed "a new era of environmentally sound economic development." But future economic decisions must be based upon environmental realities, said the commission. It used the term "sustainable development" to make the environment-economy link.

If people are going to protect such critical resources as farmland, forests and other species of life we must tailor business practices and lifestyles to fit the ecological realities of the world. This will change the way we grow food, harvest trees, generate power, produce weapons and have children.

We must favour types of economic development that fall within the planet's ability to absorb our wastes and to renew its resources. To do that we must clearly think of all the environmental impacts, whether we are making household purchases, industrial developments or government policies.

There is no question that we will have to make changes. The only debate is over whether we will make choices rapidly or have them forced upon us by events. If we choose, then we need to focus on our basic priorities and make certain they are preserved. We have to measure development proposals in terms of what they will do for or against such primal needs as fresh air, clean water, wholesome food, shelter and good health.

Change must take place not just in Canada but at a global level. If pollution keeps eroding the planet's ozone layer we will all suffer from excessive amounts of ultraviolet radiation. If the world's great forests are felled by some nations, all will feel the results of the ensuing climate changes. If the deserts of Africa keep expanding the whole world will hear the cries of the hungry.

Environmental protection includes more than putting clean-up equipment on smokestacks; it means going after the root causes of problems. The Brundtland Commission points out that

population, business expansion, arms, energy, food and pollution crises are all facets of a common global problem. To effect changes, we must deal with poverty, inequality, Third World debt and the arms race. They divert attention and resources from the struggle for a cleaner environment.

Canada and the world need to adopt a two-track approach to environmental protection. We have to continue with the traditional agenda of finding and fighting existing environmental problems and do a better job at it. At the same time we have to establish a second track, one on which people find ways to make economic development environmentally sustainable, thus preventing new problems from being created.

Canada is one of the first nations to begin a national debate on sustainable development. It was launched in 1986 when the Canadian Council of Resource and Environment Ministers created the National Task Force on Environment and Economy.

In September 1987, the 17-member task force of environment ministers, business executives, environmentalists and academics issued one of the shortest and most pointed statements ever written about the future of Canada. It placed the onus on the nation's political and business leaders to rapidly put the country on the road to sustainable development. One of its prime recommendations was that Canada's prime minister, premiers and territorial leaders create Round Tables on Environment and Economy, permanent versions of the task force.

These groups, some of which have been appointed, are to help lead Canadians through an unprecedented period of change by candidly discussing environment-economy issues and making recommendations to the nation's political and business leaders.

There are good economic reasons for change. Environmental damage and clean-ups are already costing us billions of dollars and the toll is rising fast. The risks to our present and future health are growing. But there is more than a hard-nosed practical message in sustainable development. It includes an ethical duty to our own world and to that of the next generation.

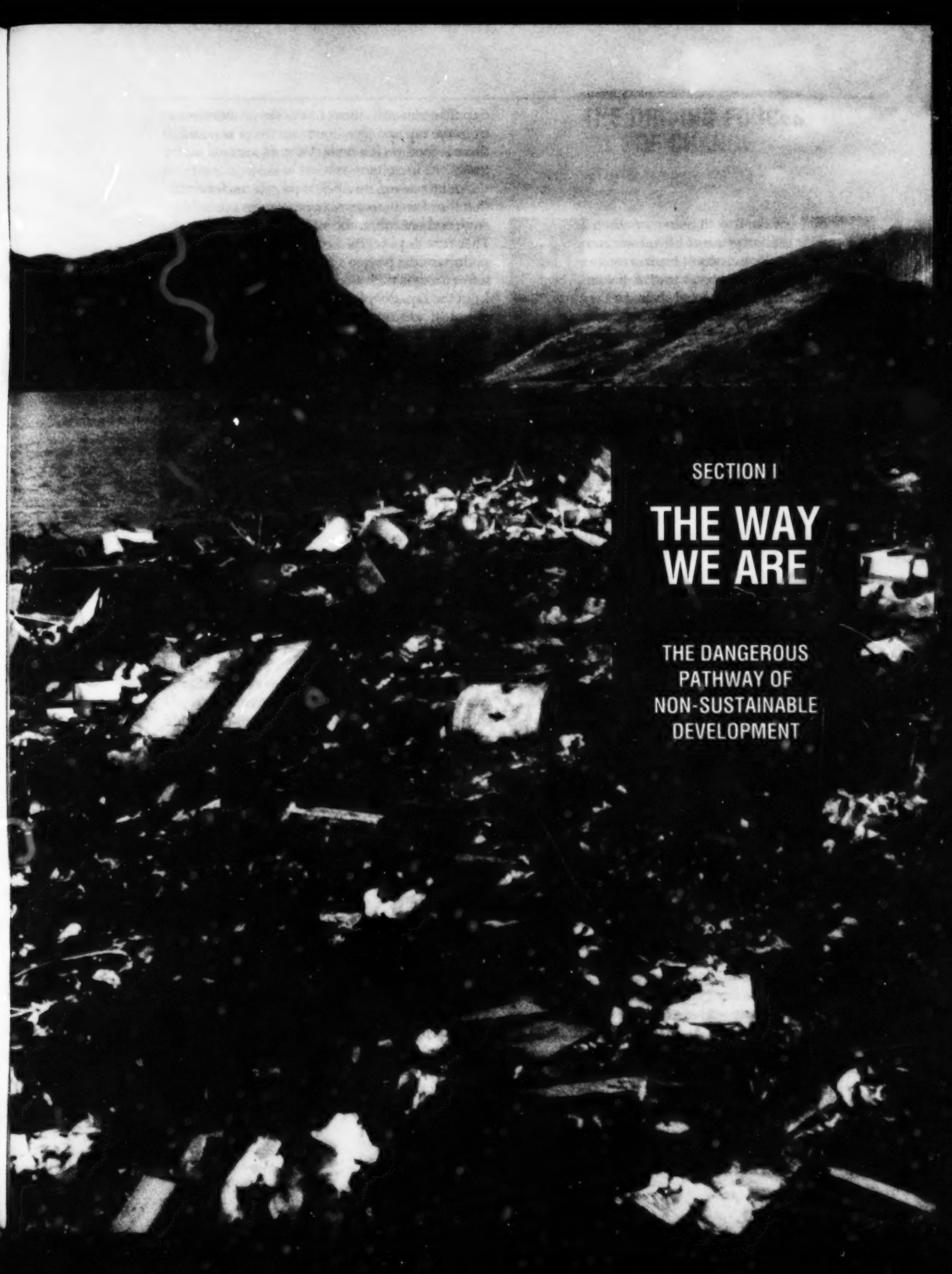
For the first time in history, future generations face the prospect of a planet made less hospitable by their parents. In its travels around the world the Brundtland Commission found some of the harshest criticism of environmental destruction coming from young people. The commissioners said the young "may damn us for our spendthrift ways, but they can never collect on our debt to them."

The message for this generation is not to stop working, inventing and changing, but to learn to do it in ways which do not destroy the planet's resource base. Some changes will be difficult and some present forms of business may cease, just as others have disappeared over the centuries. The challenge will be to find the most sustainable ways of providing for our needs and assisting people in the transition to those forms of work.

If we are to make intelligent choices about how to live and do business in a less environmentally damaging way we must have more information. This means preparing accurate and frequent state-of-the-environment reports at the regional, national and global levels so that we know what is happening and what needs the greatest attention. And we must publicize examples of sustainable forms of development already in use so people get a clearer idea of appropriate choices to make.

We must transmit environmental information rapidly and widely, for without communication there can be no action. The Brundtland Report noted that: "Progress on the issue of environment and development depends, perhaps more than in any other field, on the support of an informed public opinion. That, in turn, depends on open forms of examination and assessment and on the free flow of resulting information."

This paper is a synopsis of issues that have been in the public debate on the future of the environment. The first section examines some of the major problems that we have to deal with. The second section describes some of the changes that will be needed to start moving toward sustainable development.



SECTION I

THE WAY WE ARE

THE DANGEROUS PATHWAY OF NON-SUSTAINABLE DEVELOPMENT

For the first time in more than 3.5 billion years of life on earth and 3.5 million years of human evolution we have the power to alter the environment on a global scale, and we are using that power. The World Commission on Environment and Development, the Brundtland Commission, says: "Major, unintended changes are occurring in the atmosphere, in soils, in waters, among plants and animals." The rate of change is accelerating. This is leading to the greatest upheaval in our environment since the beginnings of civilization.

Air pollution is acidifying large areas of the earth, warming the global climate and letting increased amounts of solar radiation reach ground level. Destruction of soils and forests is allowing deserts to expand and so is reducing the amount of arable land to feed an expanding population. Lakes and rivers are being polluted and overtaxed, while underground water is being contaminated and used up faster than nature can replace it. Whole plant and animal species are being killed off faster than in any period since the upheavals that wiped out the dinosaurs.

Humans have left their wastes on every corner of the planet, in space and on the face of the moon. We are changing the thin skin of life on the hard surface of the earth and thus the way we will live in the years to come. The forests, fisheries, grazing areas, farmlands and wetlands that form the biological building blocks of our food supply and much of our raw materials are deteriorating.

The Canadian Environmental Advisory Council said: "In a profound sense, humanity is setting the geological clock back, tending to restore an early, pre-life hostile environment when acid rain washed the 'hot' metallic rocks of a radioactive world."

We have passed the time when we can think of preserving the environment even in its current, damaged state without making major changes in our behaviour. We now have to try to bring the damage to a halt as soon as possible then start healing the earth.

But despite dire warnings life, for most Canadians, goes on today much as it did yesterday. The sun still shines in the sky, water flows from the tap and gasoline from the pump and there is food on the table. Why should we worry today?

An increasing number of people understand that the changes we are beginning to see in our environment cannot be allowed to continue. There are days when the sky turns brown with pollution and people's lungs are choked. Sometimes there is pollution in the water which flows from the tap. People eat but they worry about chemical additives. Some of them wonder how they will keep putting food on the table as the Prairie soils blow through the window, carrying away the hopes for a good crop.

Now more and more people are aware that as they start up their cars the exhaust fumes are adding more acid to the rain and carbon dioxide to the heat trap forming overhead. They open the refrigerator, wondering when the gases that run it will leak and float skyward to attack the protective ozone layer. When they carry brimming bags of garbage to the curb they may question just where those tonnes of waste are going to be buried when no one wants a new dump in their backyard.

Environmental damage is more than an ethical or even a health problem. It is also a wealth problem. We are squandering the natural resources that made us rich and accumulating gigantic clean-up bills at the same time. In 1985 the Royal Commission on the Economic Union and Development Prospects for Canada said: "We are losing our agricultural land to suburbs and shopping centres. Our stands of readily accessible, high-quality timber are largely gone and our richest and most accessible deposits of ore and fossil fuels are already in production." The commission, headed by former Canadian

finance minister Donald S. Macdonald, added that "our mismanagement of the fishery has meant that we have not been able to reap the potential benefits of the designation of the 200-mile offshore zone in 1977."

All economic activity depends on a healthy environment. Over 40 per cent of Canada's Gross Domestic Product (GDP), 33 per cent of the labour force and 52 per cent of our exports can be directly related to economic activities that depend on the environment.

Our forests yield $30 billion a year in wood products and contribute more than $17 billion to Canada's trade balance. The industry provides 265,000 directly related jobs and one in 10 Canadians relies on the forestry or related companies for work. The food industry contributes more than $18 billion to the GDP and a trade surplus of $2 billion. Wetlands support economic activities worth over $4.6 billion a year based on wildlife watching, hunting and trapping.

Today's problems are serious for thousands in Canada and critical for hundreds of millions in poor nations where water is scarce, the trees are being cut for cash or firewood and the land is turning to dust. Even though the world produces more food than ever at least 730 million people cannot get enough to eat, while about 1.3 billion cannot get adequate supplies of safe drinking water. "The per capita availability of land and water is going down at a frightening rate in most developing countries," said James MacNeill, former secretary-general of the Brundtland Commission.

While most Canadians do not suffer directly from the poverty and environmental degradation felt in the developing world, we will be affected indirectly. The disappearance of tropical rain forests will bring adverse changes in the global climate. It also means the loss of countless plant and animal species. With them will go not only the beauty and magic of life itself but the possibility of using those plants and animals to develop more and better foods and medicines.

When other countries fire up huge power plants or release chemicals into the air, we, in Canada, will feel the effects. Climate change from air pollution will shift temperatures more dramatically at northern latitudes than at the equator.

THE DRIVING FORCES OF CHANGE

There are several myths and assumptions that humans have used to justify the resource exploitation and pollution during the past two centuries of industrial development. First there is the assumption that humans have a divine right to conquer and exploit nature and that this can be done without harming ourselves.

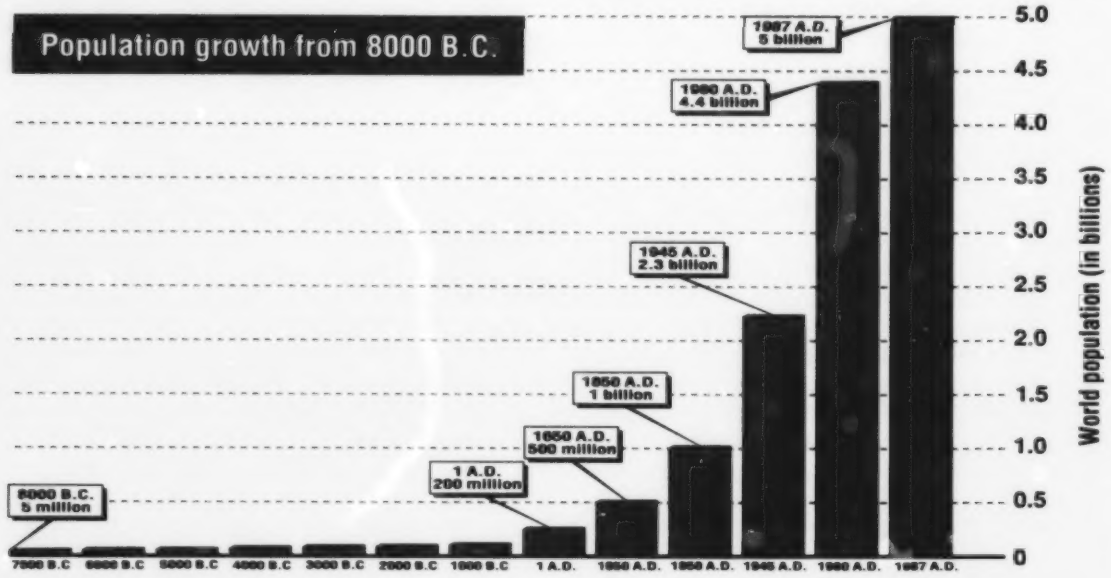
That has been coupled with the myth of super-abundance, of endless forests, bottomless wells and of more virgin land ready to be settled. The myth is based on a view of nature as mainly a storehouse of natural resources to be tapped at will. For example in Canada we look north to see a blue and green wilderness of rocks, trees and an endless expanse of lakes, rivers and ponds. The vastness of the terrain has fostered a belief that we can never run out of minerals, trees, water and other necessities. It is this dangerous self-deception that lies at the root of many of our problems.

Another myth is that the solution to pollution is dilution, a phrase that is becoming an epitaph for once-clean air, land and water. The theory is that if you dump a small enough amount of a substance into a large enough lake, river or the sky, it will vanish or at least become harmless.

In the past there were relatively few polluters and most of the wastes were biodegradable, so the environment could absorb, dilute and eventually break down most garbage. But in recent decades we have been using heat, pressure and a host of chemicals to produce substances never found in nature. Some are almost indestructible under natural conditions, while others break down into harmful metabolites. The release of toxic waste deposits in one region after another is destroying the environment by a million tiny knife cuts.

The pressures are growing because there are more people than ever before and most want more of everything. Our time to study and react is shrinking rapidly.

For tens of thousands of years there was little urgency to adapt as the human population grew ever so slowly. At the end of the last ice age, 10,000 years ago, there were probably no more than 5 million humans. By the dawn of agriculture, some 8,000 years ago, the population was



only about 8 million and by the birth of Christ it was probably around 200 million. What we now call the population explosion did not start until the industrial revolution, two centuries ago. By 1850 the world's population was 1 billion, by 1930 it was 2 billion, by 1960 it reached 3 billion, by 1975 it hit 4 billion and in 1987 it reached the 5 billion mark.

Every second more than two more people join the world and every year we add the equivalent more than three Canadas to the face of the globe. By the end of this century the world population will be over 6 billion and 20 years later it will be 8 billion and by the middle of the next century it is likely to be 10 billion.

Forecasts based on present trends indicate that more than 90 per cent of the population growth in the next few decades will come in the developing nations, which are least equipped to feed new mouths and shelter more bodies. The Brundtland Report, *Our Common Future*, says that, "in many parts of the world, the population is growing at rates that cannot be sustained by available environmental resources." Yet the report adds that somehow we are going to have to feed, house, clothe and provide many other goods and services for billions more people.

But it is not just the population increase that is putting a strain on the planet's environment. It is the growing demand by everyone for more of everything that is creating a vast increase in the demand for raw resources and in the output of pollution.

The increase in economic activity is even more dramatic than the population growth. Overall economic activity has grown 20-fold since 1900. The use of fossil fuels grew by a factor of 30, and industrial production by a factor of 50. Around the world humans are adding 1,000 to 2,000 new chemicals to the market each year though we still do not understand the health or environmental implications of most of the 100,000 or so already in use.

Eighty per cent of the world's economic growth has taken place since 1950 and most of it was in a relatively few industrially developed countries. Now industries that are the most heavily dependent on natural resources and are the most heavily polluting are expanding rapidly in the developing world. And global industrial expansion is just beginning. The Brundtland Report says that energy use alone would have to increase by a factor of eight just to bring developing countries, with their present populations, up to the level of the industrialized nations. It predicts that, as the population doubles in the next half-century, the world economy, now worth $13 trillion a year, will multiply five to 10 times. And it warns that if the new development is as environmentally blind as the old, it will create conditions "that the planet and its people cannot long bear."

The combination of a growing population and already intolerable pressures on the environment sets the scene for massive change. As Brundtland makes clear the world has to be fed, clothed, housed and provided with work. But it cannot be done in the same, old way.

EVERYONE IS INVOLVED

Global atmospheric pollution means there is no longer a Shangri-la, a corner of the world where you can go and say that the ravages of pollution cannot touch you. We all are exposed to the hazards of pollution so we must all be involved in a major change in business practices and lifestyles to reduce human impact on the environment.

This is true even in Canada, which has less than one half of one per cent of the world's population on seven per cent of the world's land mass. Despite the apparent wide-open spaces, all regions of Canada have some environmental problems. Climate change, the thinning ozone layer and toxic wastes affect the whole country. Forestry and fishery shortages keep cropping up in one area after another. Almost all urban areas are having a difficult time finding new dumpsites.

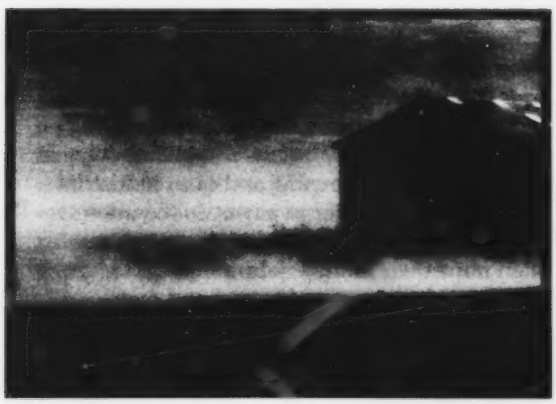
The Atlantic provinces suffer from inadequate sewage treatment, from leaking underground oil storage tanks and from agricultural chemicals and industrial wastes seeping into drinking water. Acid rain has already destroyed life in several Nova Scotia salmon rivers .

In Quebec and Ontario acid rain is a major issue, threatening life in hundreds of thousands of lakes and rivers. Acids and other air pollutants are implicated in the premature death of large stands of trees, particularly the maples of southern Quebec. Unsafe chemical storage is a serious problem as the fire at a PCB storage depot at Saint-Basile-le-Grand showed in 1988 and the leakage at the Smithville site in Ontario showed even earlier. Chemical pollution, human and livestock wastes make some waters questionable or even clearly unfit to drink. In many parts of the Great Lakes-St. Lawrence ecosystem fish are either unsafe to eat or are fit only for limited consumption. A significant number of fish have cancerous growths. Dead beluga whales in the St. Lawrence estuary are so laden with chemicals that they qualify as hazardous waste sites.

Across the Prairie provinces regional water shortages and the loss of valuable topsoils leap to the head of the list. The 1988 drought was just the latest in a series of such dry years in this decade and the worst in western Canada in over 50 years. It reduced Canadian wheat production by 41 per cent. The effects of agricultural chemicals in the land and water and the loss of wildlife habitat in the continent's greatest natural duck hatchery are also issues of regional and national concern. World Wildlife Fund Canada has stated that the Prairie grasslands are among the most endangered habitat anywhere.

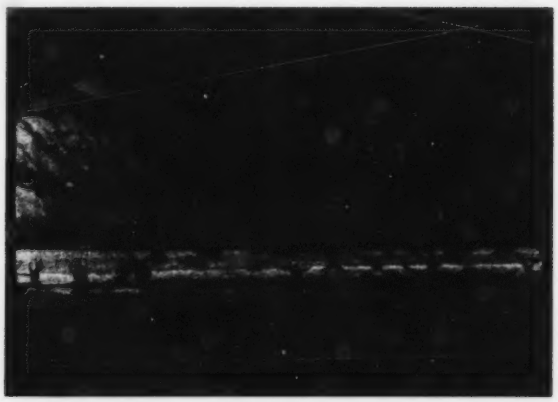
Heated controversy keeps flaring up in British Columbia over how much of the impressive virgin forests, which hold some of the biggest trees anywhere, should be preserved. These disputes are often entwined with native land claims. Complicating the picture are conflicts over pesticide spraying, untreated sewage, waste disposal, industrial chemicals and long-term plans to dam rivers for hydroelectric power. Chemicals used as wood preservatives and chemical wastes from pulp mills have become serious issues in recent years.

In the Yukon and Northwest Territories there is relatively little obvious environmental damage in comparison to the vast areas still in a relatively pristine state. But concerns are growing



over mine wastes polluting the water, the effects of hydro-electric dams on downstream areas, the threat of pollution from Arctic oil projects and the future of wildlife. Air pollution known as Arctic haze periodically thickens with wastes blown from industrial areas thousands of kilometres away. Radioactive fallout from past atmospheric weapons tests and from the Chernobyl power plant accident are being passed through the Arctic food chain. So is the fallout from industrial chemicals and pesticides used in other parts of the world. There are concerns about the long-term health effects of this pollution on northerners who eat fatty animal tissues, where chemicals are concentrated.

Many serious environmental issues, such as climate change, ozone depletion, acid rain, transboundary water quality, protection of wilderness and migratory species, lie beyond the control of a single nation or region. Children in Moose Jaw or Chicoutimi are going to be dramatically affected by what the adults in Toronto, Pittsburg, Moscow, Beijing, Brasilia and Tokyo do. They will get skin cancer if the world does not save the ozone layer. Their weather will change if the industrial centres do not stop injecting billions of tonnes of pollution a year into the sky, creating the greenhouse effect.



INTERNATIONAL ACTION

Canadians will have to work hard just to get our own environment in order. We will have to work even harder to help forge agreements under which all nations co-operate to save the common environment. It will not be easy. The issues are complex and interrelated.

For example, we look at images of the developing world and see rain forests being leveled, deserts advancing and old cars, trucks and factories belching pollution into the air. The main reason poor nations have such problems, says the Brundtland Report, is simply because they are poor. Many countries do not have the money to refit their dirty and aging industries with the latest clean technology. Some nations have virtually no industry and their people are forced to destroy trees and arable land in a struggle to feed themselves on a day-to-day basis.

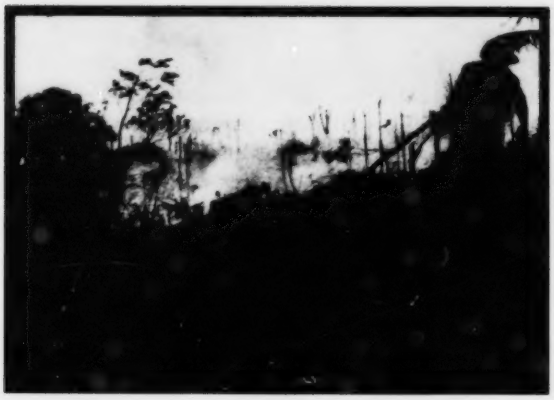
In a speech to the United Nations in 1987, Tom McMillan, then Canada's environment minister, said that the industrialized world has a responsibility to help poorer nations save their environments. "We may not ourselves strip their rain forests of virgin timber," said Mr. McMillan, "but we certainly bear some responsibility for the conditions that compel those who do."

The forces behind world poverty are many and complex. Some lie in the hands of those who have economic, military and political power in poor nations. But others are controlled from outside. For example, the prices of many commodities produced by poor nations, ranging from cotton to oil, have fallen in recent years. At the same time they are saddled with foreign debts so large they cannot even pay the interest.

In order to repay their debts and qualify for more financial assistance from wealthy nations, poor countries are encouraged by rich nations and international bankers to reduce spending on domestic programs. The cuts sometimes come in health, education, housing and even industrial development. In order to pay even the interest on their foreign debts people in poor nations often mine their limited natural resources, cutting down forests, over-farming and overgrazing the land.

Instead of producing corn, wheat or rice, Third World farmers are growing and exporting increasing amounts of meat, coffee, oranges and sugar – foods they cannot afford to eat. More than one quarter of Central America's rain forests have been destroyed since 1960 for cattle ranching and 85 to 95 per cent of the meat goes for hamburger, tinned meat and pet food for North America. Meanwhile, the consumption of beef per person has fallen in Central America.

As of early 1989 the developing countries owed $1.3 trillion (U.S.) to the richer countries and their poverty was increasing. A combination of high interest rates and a drop in loans to poor nations meant they were paying $50 billion a year more than they received in development



assistance. Debt repayment policies by rich nations and financial institutions have helped to reduce living standards by 15 per cent in parts of Latin America and 25 per cent in the Sahel region of Africa. One billion people live in poverty and squalor, and a majority of developing nations have a smaller per capita income now than in 1980. This is followed by a deterioration in nutrition standards, health care and education. Millions of children in developing countries have died because of policies of creditor nations, according to the head of the United Nations Children's Fund in June 1988.

Many developed nations are subsidizing overproduction of food at home in order to maintain farm incomes but one side-effect is the creation of food surpluses that drive down the prices of commodities such as sugar, which are exported by the developing world.

THE MAJOR ISSUES
CHANGING THE ATMOSPHERE

The atmosphere, the mix of clear gases that reaches for about 100 kilometres over our heads, is what we breathe and what creates the climate and weather patterns that govern our lives. The state of that atmosphere is being increasingly threatened by growing amounts of chemical pollution. Huge amounts of carbon dioxide, acid gases and ozone-destroying chemicals pour into the air. The chemicals circle the world and have made environmental problems truly global in nature.

A major international conference held in Toronto in June 1988 warned that air pollution must be curbed or there would be serious problems in global security and political stability. The final report of the conference, called "The Changing Atmosphere: Implications for Global Security," said: "Humanity is conducting an unintended, uncontrolled, globally pervasive experiment whose ultimate consequences could be second only to nuclear war."

The meeting of scientists and politicians from around the world blamed a mixture of industrial discharges, exhaust fumes, some agricultural practices and steady deforestation for creating a new balance of gases in the sky and hazardous fallout on the land and water below.

Climate Change and the Greenhouse Effect

Our atmosphere has long been a natural greenhouse. If it were not for the blanket of carbon dioxide, water vapour and other gases that evolved over billions of years, the planet would be as cold and inhospitable as the moon. But we are rapidly changing our atmosphere by injecting huge amounts of such gases as carbon dioxide, nitrous oxides, methane and chlorofluorocarbons into the air. They are increasing the natural greenhouse effect, thus launching a planetary warming more rapid than anything in recorded history.

Most scientists are reluctant to say the droughts of 1988 were caused by an early appearance of the greenhouse effect but they say that these are the kinds of conditions to be

expected under climate change. And they note that the world has warmed up more than one half a degree Celsius since accurate measurements were started 130 years ago. Globally, five of the warmest years in more than a century of accurate record-keeping were in the 1980s. Lakes in northwestern Ontario are 3 degrees warmer than they were 20 years ago and are ice-free for 15 days more.

Scientists are not sure how fast our climate will warm up. A lot depends on how the oceans and atmosphere behave and how much pollution we keep pumping out. But they do predict a global warming of from 1.5 to 4.5 degrees by as soon as 2030. They say the effects will be noticeable within a decade and will be more extreme in high latitudes such as Canada's north.

As the atmosphere warms up, the planet's whole heat-circulation system will be speeded up, causing changes in the global patterns of wind and ocean currents. There will be more rain and snow in some areas and less in others.

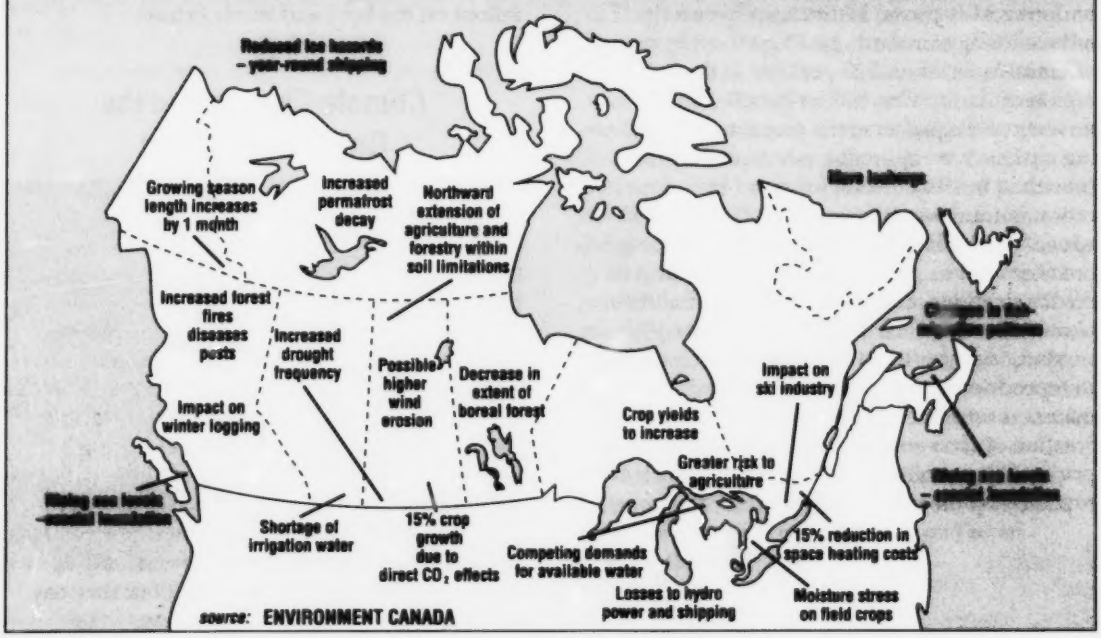
The central part of North America is forecast to have much higher temperatures and less moisture to grow crops. Across Canada there will generally be milder winters and hotter summers. The eastern and central parts of the country are likely to get drier while the west and north will get wetter. As a result, the Prairies are predicted to face more frequent and severe droughts of the type that have caused hundreds of millions of dollars in losses since 1984. The same fate is predicted for other major world breadbasket, including the High Plains of the United States, the Great Plains of China and possibly the southern part of the Soviet Union.

According to a 1987 conference on sudden climate change, "Worldwide food shortages and famine are likely to occur from any large-scale environmental or climatic change." The conference of 50 scientists and humanists from the Soviet Union, Europe and North America was held by the Calgary Institute for the Humanities.

At the same time, climate warming will cause the Great Lakes to drop as much as one metre because of greater evaporation. This means there will be less water to turn electric turbines and float cargo ships or keep harbours open. Marshes, the home of much wildlife, will dry up and there will be less water to dilute pollution.

The 1988 drought gave a foretaste of what may happen when water levels fall. When the Mississippi River hit the lowest level recorded, there were calls from some U.S. officials for more water from Lake Michigan. This would have meant allowing more water from the Great Lakes and thus from Canada to flow through the existing Chicago diversion to the Mississippi

The 'Greenhouse Effect' on Canada


Reduced ice hazards – year-round shipping
Growing season length increases by 1 month
Increased permafrost decay
Northward extension of agriculture and forestry within soil limitations
More icebergs
Increased forest fires diseases pests
Increased drought frequency
Possible higher wind erosion
Decrease in extent of boreal forest
Impact on winter logging
Impact on ski industry
Crop yields to increase
Greater risk to agriculture
Rising sea levels – coastal inundation
Shortage of irrigation water
15% crop growth due to direct CO_2 effects
Competing demands for available water
15% reduction in space heating costs
Losses to hydro power and shipping
Moisture stress on field crops
source: ENVIRONMENT CANADA

system. The suggestion provoked a major Parliamentary debate about water diversions and led to Government promises to pass laws against such exports. However, if such mid-western droughts become more frequent there will likely be more calls from dry states for water imports.

While water levels are predicted to fall in the interior of North America, they will rise on the seacoasts. The world's oceans will swell with global heating, just as a pot boils over on a stove. The Atmospheric Environment Service of Environment Canada uses international estimates to predict that within 40 years the oceans could be higher by a metre, causing major flooding in parts of the Maritimes such as Charlottetown and Saint John.

If temperatures keep rising, the polar icecaps will gradually melt and the oceans could rise five to seven metres over a century or so. This would cut Prince Edward Island into three or four islands and reduce Florida by one quarter or more. Even a sea rise of one metre would literally swamp many low-lying coral atolls. About one third of the world lives in areas which will be threatened with increasing flooding over coming decades. Dykes in the Netherlands will hold for years and can be raised more but nations which, like Bangladesh, already suffer from severe flooding, will face an impossible job of stopping the seas.

The ice barriers of the Arctic will melt back, opening the Northwest Passage to commercial and military shipping and this will test Canada's claim to sovereignty over the waters of the Canadian Archipelago.

Canada's forests will migrate northward at the rate of 100 kilometres for every degree of warming and the boreal forest will eventually reach the Arctic Ocean. But the rate of warming will likely be so fast that tree seedlings planted now will grow up to find a climate to which they are ill-adapted.

Weather in Canada and worldwide will become more extreme, leading to more storms like those that wrought havoc in the Caribbean in 1988 with the most powerful winds in decades. Storm tracks will also shift, meaning that new areas will be at risk. Monsoon rains that water much of Asia will likely not fall in their age-old patterns and this could cause more crop failures.

Unfortunately, the substances causing most of the climate change are part of the industrial cycle. Carbon dioxide, the major greenhouse gas, is the by-product of all forms of combustion, including burning forests, industrial smokestacks, household chimneys and motor vehicle tailpipes.

About 90 per cent of global energy comes from carbon-based fuels: oil, coal, gas and wood. It amounts to the equivalent of 10 billion tonnes of coal per year. Between the burning of carbon fuels, and the clearing and frequent burning of forests, humans release 7 to 9 billion tonnes of carbon dioxide into the atmosphere every year. ("Tonnes of carbon dioxide" refers to tonnes of carbon released into the atmosphere in the form of carbon dioxide.)

Experts at the 1988 atmosphere conference in Toronto said that so much pollution has gone into the sky that climate change is inevitable. To prevent it from growing even more severe they said the world has to cut its CO_2 pollution by more than half. Canadians are among the world's greatest energy consumers, using only slightly less than Americans but 2.5 times as much as most Europeans and 4.5 times as much as the world average. Despite extensive use of hydro-electricity and nuclear power we produce about 4 tonnes of carbon dioxide per capita per year.

In addition to CO_2 the world releases huge amounts of other greenhouse gases. These include industrial chemicals such as chlorofluorocarbons, waste gases like nitrous oxide and methane from agricultural practices.

The Ozone Layer

Another atmospheric change, the thinning of the ozone layer, poses a serious threat to life on Earth. The natural ozone layer in the stratosphere, from 15 to 35 kilometres overhead, screens out harmful amounts of ultraviolet light

from the sun. The amount that gets through is still enough to cause sunburn and some skin cancer.

As pollution eats away the ozone layer, more ultraviolet light streams to earth, increasing the amount of skin cancer, eye cataracts and other illnesses. This UV-B radiation is known to suppress the immune system, leading some experts to say we risk more AIDS-like diseases. It also attacks such major food crops as wheat, rice, corn and soybeans, damages phytoplankton in the ocean, and causes paints and plastics to discolour and deteriorate.

For every one-per-cent decrease in the ozone layer there is a two-per-cent increase in UV-B radiation and a four-per-cent increase in the risk of some types of skin cancers. Scientists say the ozone layer at latitudes such as Toronto's has thinned by three to four per cent in the past three decades. In 1986 Alex Chisholm, a senior federal atmospheric expert, estimated that Canadians already faced an eight- to 16-per-cent greater risk of skin cancer because of the increased radiation. Each year 500 Canadians die from skin cancer and about 40,000 more contract forms of this disease. The thinning ozone layer means those rates are likely to rise in the future.

Effects of ozone damage: field of beans

The loss of the ozone layer is unpredictable; no one is sure how fast it will change or how far it will go. Experience in the Antarctic shows that in some areas the loss can be sudden and dramatic. Scientists have measured losses of 50 per cent in the ozone layer over millions of square kilometres of the southern end of the planet for as long as two months. A similar but smaller hole has appeared at least twice over the Arctic during winters in the 1980s.

The chemicals that attack the ozone layer are mainly industrial gases called chlorofluorocarbons (CFCs), halons and methyl chloroform. CFCs run Canada's 23 million refrigerators, freezers, air conditioners and other pieces of cooling equipment. Our 9.5 million refrigerators alone contain about 2,700 tonnes of CFCs. Around the world CFCs are used to make a number of foam plastics and to clean delicate electrical equipment such as computer chips, and they are used in some spray cans.

At a global level about one million tonnes of CFCs are made every year. Virtually all escape into the atmosphere where some are predicted to keep attacking the ozone layer for a century.

Acid and Toxic Rain

Acid rain, which has been recognized as a serious threat to Canada's environment for more than a decade, begins as colorless sulphur and nitrogen gases, spewing from millions of chimneys, smokestacks and exhaust pipes. These gases, and the acids they form in the rain and snow, can travel thousands of kilometres. When acid gases, dry particles and liquids fall to earth they attack lakes and rivers, forests, crops, buildings, monuments, cars and human health.

Almost half of Canada is highly sensitive to acid rain, and more than 80 per cent of Canadians live in areas where there are rates of acidic fallout high enough to acidify many lakes. The corrosive fallout has already damaged 100,000 of 700,000 lakes in eastern Canada and is putting another 300,000 at risk. About 14,000 lakes are believed by scientists to be biologically dead.

More than half of eastern Canada's forests grow in areas where rainfall is heavily polluted, and since the mid-1980s there has been extensive and unexpected death of trees, particularly in Quebec. A broad band of forest from north of Ottawa to the Gaspé area is affected. Aerial surveys have found that trees in all of Quebec's maple forests, a band of trees extending over 24,000 square kilometres, have been damaged.

The premature death of maple trees has reached such proportions that there are predictions that maple syrup may become a rare commodity and the blaze of fall colors will fade. The jobs of 25,000 people in Canada and the northeastern United States are at risk, and maple syrup producers in Quebec are claiming $86 million a year in compensation for the damage they attribute to air pollution. Quebec environment experts say that the decline of

hardwood forests will likely accelerate as insect-eating birds lose their habitat and the bugs move in to prey on the weakened trees.

When one adds the corrosion and erosion damage to cars, buildings, bridges and monuments, federal officials estimate the cost of acid rain in Canada at $1 billion a year.

Around the world there are similar damage reports. Half the forests in Germany and huge areas of the forests of central Europe are affected.

And the acids are eating away at the monuments of civilization. The surfaces of buildings and statues that have stood for millennia are now being dissolved within decades. The Acropolis of Athens, statues in Rome, cathedrals of Europe, the Taj Mahal of India, the Statue of Liberty and Canada's Parliament Buildings are all discoloring, peeling and eroding. Chalky, white stains and black crusts on the facades of monuments and buildings are hallmarks of acid damage. Stained-glass windows which have inspired people with their delicate beauty for centuries are being destroyed. It has cost $1.5 million to repair Montreal's city hall and uncounted amounts to repair homes around the world. The acids literally dissolve the mortar that holds bricks and stones together and they turn paint to powder.

Around the world 200 to 250 million tonnes a year of sulphur and nitrogen gases are released into the atmosphere.

But acids are just part of the mix of pollutants that fall on our heads. Millions of tonnes of other chemicals and metals spew from chimneys or evaporate from farm fields and polluted waterways to form a thin but perceptible film around the globe.

Great, invisible rivers of air pollution carry a host of other toxic substances across the sky to fall on urban and rural areas alike. As the fallout from the 1986 nuclear accident at Chernobyl in the Soviet Union showed, pollution can circle the planet in 11 days.

A host of heavy metals, industrial chemicals and pesticides turns up not only in the inhabitants of industrial centres but in the flesh of polar bears in the Arctic and penguins in the Antarctic. Pollution from North America, Europe and the Soviet Union forms a brownish-yellow haze in the Arctic and its fallout leaves soot-blackened snow in the far north. The Arctic snow pack contains agricultural and industrial chemicals including PAHs, lindane, dieldrin, heptachlor epoxide, chlordane, DDE, PCBs and Endosulfan. These chemicals have worked their way through the food chain and are now recorded in significant amounts in humans who eat a lot of wild foods.

Air pollution, including tiny droplets of acids, known as aerosols, poses a threat to our health. Tests have shown that children living in areas of high air pollution have decreased lung function when compared to those in cleaner regions. Hospital admissions for respiratory ailments rise during high pollution episodes. The fallout also gets into the food chain, from which we get about 80 per cent of our intake of chemicals.

Nuclear Winter

The greatest threat to the environment remains that of nuclear war although the risk of such a conflict, at least between the superpowers, appears to be receding. For years there has been growing evidence that fallout from a major war would render much of the planet unfit for life. During the 1980s scientists from the Eastern and Western blocs agreed that a major war would almost certainly trigger a nuclear winter. Smoke spewing from burning cities and fields would blot out the sun for weeks at a time. Temperatures would plunge and there would be massive crop failures around the planet. Whole classes of plants could be wiped out, and humans who survived the blasts and radiation could expect to freeze and starve in the gloom.

CHANGING THE LAND

Human activity is stripping the green mantle of the planet. Until a few centuries ago forests covered 60 million square kilometres of Earth but they have been cut and burned back by one third. The greatest loss is in the tropics. A century ago there were about 15 million square kilometres of tropical forests but now there are only nine million. The Brundtland Commission has estimated that at the current rate of loss only the rain forests in parts of central Africa, South America and New Guinea will have remained uncut by early in the next century.

It is hard to get precise figures on the rate of loss, but a common estimate has been that every year 110,000 square kilometres of the world's tropical rain forests, an area twice the size of Nova Scotia, are destroyed. With the loss of other tropical and temperate forests, the total loss is as high as 150,000 to 200,000 square kilometres a year.

But even this dramatic figure may be conservative. Using satellite images Brazil's space research institute found that more than 194,000 square kilometres of forests were burned in that nation in 1987 alone. The burning continues as settlers pour into Amazonia to carve out farms and ranches. One industrial project, known as Carajas, calls for the cutting of 15,000 square kilometres of trees, an area three times the size of Prince Edward Island. The trees are to produce charcoal fuel for metal smelters in the area.

Noel Brown, head of the United Nations Environment Programme in North America, says that global deforestation means humans are cutting out "the lungs of the world" and threatening our very oxygen supply. And by depleting the number of trees we reduce nature's ability to soak up carbon dioxide from our industries. The loss of forests also means the loss of life forms which date back into our prehistory. Some tropical rain forests in southeast Asia are 130 million years old. They outlasted the dinosaurs and ice ages but are now being cut by humans.

Despite massive cutting since the last century Canada still has nearly two million square kilometres of forests. But the amount of timber close enough to roads and mills to be commercially usable is only half that amount and it is shrinking. One eighth of the country's productive forest, about 240,000 square kilometres, has lost its commercially valuable trees because of fires, insects, disease and failure to replant. Between 1975 and 1983, about 8,000 square kilometres of forest were cut but only 2,000 were replanted. Although tree planting has increased in recent years, the trees will not be ready for harvest for as long as 60 years.

In 1988 the Auditor General's report said: "Significant shortages of wood are now reported at the local level in every province. Restocking of productive forest lands has not kept pace with the harvest and this threatens future forest productivity."

Forestry should be farming in slow motion but is still too often a cut-and-run operation in which the forest is not helped to regrow. Worldwide, 10 trees are being cut for every one planted; in Africa the ratio is 29 to 1.

As the forests are cut back and grasslands over-grazed or farmed too intensively the deserts expand. One-third of the planet is already desert, of which 6 per cent is extremely dry and the rest is arid to semi-arid. The deserts are growing at a rate of 60,000 square kilometres a year, an area larger than Nova Scotia and Prince Edward Island together. At the current rate another 38 million square kilometres in 63 countries, one quarter of the land mass of the world, is in danger of becoming desert.

When the land dries up, fertile soil created over millennia is blown or washed into rivers and the sea. Around the world an estimated 24 billion tonnes of soil are lost each year, and fertility has been reduced on cropland twice the area of Canada.

In Canada the damage to land from human impact is already significant: about 20 per cent of our farmland is deteriorating. The Prairies

alone lose 300 million tonnes of soil a year to erosion. Across the country land on the 293,000 farms is damaged by salinization, alkalization, acidification, waterlogging and compaction by heavy farm machines – all by-products of modern agriculture. In some cases the land becomes virtual desert because it is no longer productive.

According to Elaine Wheaton of the Saskatchewan Research Council, "Fertilizers used by farmers mask the fact that organic matter and biomass have reduced by about 50 per cent since the land was first broken." About half the nitrogen in the West has been exported in the form of grain since large-scale farming began less than a century ago, and soil is being lost 10 times faster than it is being formed. In Prince Edward Island and New Brunswick bare stones and bedrock are appearing in the midst of once-rich farm fields while mud being washed into the ocean is harming the fisheries.

In 1984 the Senate Standing Committee on Agriculture, Forestry and Fisheries produced *Soil At Risk*, a report that estimated that soil degradation in Canada costs farmers $1 billion a year. The federal agriculture department estimated that in 1984, Canada lost as much as $1.4 billion when one counts the costs of pollution and sedimentation off the farms.

To cultivate new land some farmers are ripping out shelter belts of trees which were planted after the 1930s dustbowl years to reduce erosion and to collect the winter snowfall. They plow under small wetlands, which help preserve moisture and provide wildlife habitat.

Large areas of farmland are being lost to urbanization because of settlement patterns which start cities around the best farming areas. As the cities expand they cover the soils which spawned them. One can see much of Canada's best farmland from the towers of its cities but each year more of the land is paved.

Across Canada we are losing an estimated 100 square kilometres of farmland every year. Most of it is in the best growing regions such as southern Ontario, the St. Lawrence lowlands of Quebec and the fruit and vegetable growing regions of British Columbia, such as the Fraser and Okanagan valleys. These losses are not because farmers want to destroy the land, but economic forces make it very hard to resist. If a farmer is in debt, it is very tempting to plow every little bit of land just to meet the bank payments. If a farmer can make make enough money to retire by selling the land for a subdivision, it is hard to say no.

Even government policies aimed at helping farmers can undermine the farms themselves. Governments around the world spend about $100 billion a year in subsidies. According to James MacNeill, secretary-general to the Brundtland Commission, many of these payments encourage farmers to occupy marginal lands and to clear forests and woodlands that should be preserved. Grants subsidize the excessive use of pesticides, fertilizers and scarce underground water reserves. Mr. MacNeill, now environment director of the Institute for Research on Public Policy in Ottawa, said that agricultural policies give more money for practices that destroy the land than for those that conserve it.

Many other valuable lands are at risk, notably Canada's wetlands, which are the nurseries for much of the nation's wildlife. On the surface of our wetlands float all our ducks, geese and swans, while the bitterns, rails, herons and sandpipers walk the shores and wade the shallows. The waters, reeds, cattails and shrubs are home to a wide variety of other fish, reptiles, birds and mammals.

Environment Canada estimates that over one-half of the original wetlands of southern Canada have been lost. This includes 65 per cent of the Atlantic coastal marshes, 70 per cent of wetlands in southern Ontario and Quebec, including 90 per cent of those in southwestern Ontario, and 80 per cent of the Fraser River Delta wetlands.

Western wetlands were once among the richest in the world. Prairie potholes are the breeding ground for 70 per cent of the continent's ducks. They once covered 750,000 square kilometres but in the three Prairie provinces they have shrunk by 27 to 61 per cent depending on the area and are being drained at the rate of 11 to 21 per cent a year. The combination of habitat

loss and severe droughts in the 1980s sent duck populations crashing to levels reminiscent of the dustbowl years of the 1930s.

The tallgrass Prairie has almost vanished beneath the plow. The largest area still preserved is 10 hectares in a park within the Winnipeg city limits. According to Monte Hummel, president of World Wildlife Fund Canada, "the Prairie grasslands and aspen park lands are the most endangered wildlife habitat in this country." They are home to half the 165 endangered species in the country.

CHANGING THE WATERS

Fresh Water

Water is the lifeblood of the environment and the striking point for such diverse issues as pollution, food production and the future of wildlife.

Our world appears as the blue planet in photographs taken from space. More than 70 per cent of the surface is covered with water and it seems inconceivable that there could be water shortages, least of all in Canada. In a nation that holds about 20 per cent of the world's fresh water in its lakes and has nine per cent of the world's river flow in its streams, we have assumed that the tap could never run dry.

But even in Canada, which has so many lakes they have not all been counted, the assumption that there is unlimited clean water for everyone is turning into an illusion. Hundreds of thousands of people drink water piped in from somewhere else because their original sources were overtaxed or polluted. Local and regional water shortages are predicted to become more frequent and more severe as an increasing population puts ever greater demands on this resource.

In a major assessment of the state of Canada's well water, Environment Canada found reports of pollution from Prince Edward Island to British Columbia. "Contamination of ground water... with pesticides and other organic and inorganic chemicals is becoming a major, nationwide problem. Organic chemicals have been detected and wells have been closed in all regions of the country."

The report continued: "We are in great danger of contaminating our ground water irreversibly with carcinogens and other toxic pollutants from our practices of waste disposal, application of pesticides and from other industrial, agricultural and residential activities." The Science Council of Canada reported in 1988 that as many as a million Canadians may already be risking their health by drinking contaminated well water.

In Canada more than one quarter of the population lacks sewage treatment. Only 1,442 of 3,250 Canadian communities have some form of sewage treatment, and 1,000 have no sewers and dump untreated wastes into lakes, rivers and the oceans. The picture will improve somewhat over the next few years as the result of sewage

treatment programs, particularly in Quebec and the Maritimes. Some remote areas have a standard of drinking water and sewage treatment systems well below the national average and even below World Health Organization guidelines.

Worldwide, the toll in disease and death from waterborne diseases is staggering. About 1.3 billion people or nearly one quarter of the world lacks safe drinking water and 1.7 billion lack water for sanitation. Every year about 25 million people, the equivalent of the population of Canada, die from preventable waterborne diseases. It is as if seven fully loaded jumbo jets crashed every hour and there were no survivors. Hundreds of millions more suffer from diseases related to unsafe waters.

Water experts are predicting that a number of nations will outgrow their water supplies over the next couple of decades while others will suffer limited but damaging droughts.

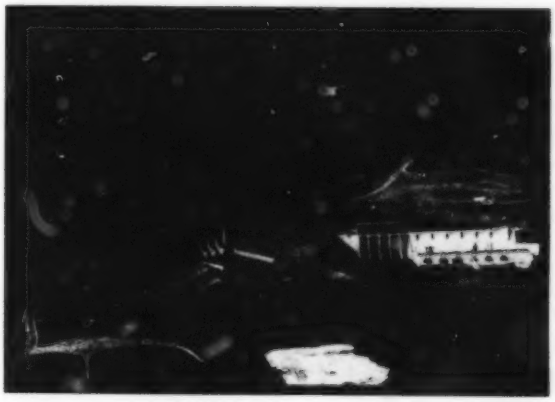
Even Canada, with all its lakes and rivers, has growing water-supply problems. On the Prairies some rivers run so shallow in dry years that farmers have to let their crops wither. Parts of the Milk, St. Mary, North and South Saskatchewan and Red-Assiniboine rivers do not have enough water for all the demand during dry spells. Water is also scarce in parts of the Okanagan Valley, a semi-arid region, and is becoming scarce in heavily populated parts of southern Ontario.

Water shortages and increasing pollution problems are fueling a demand for more and more water diversions. Some towns and cities have had to build expensive pipelines to large lakes and rivers just to get enough water. Others, such as Niagara-on-the-Lake and towns along the St. Clair River, both areas downstream from chemical industries, have demanded water pipelines from cleaner sources.

With predictions that climate change will bring more droughts to western North America there is more talk of continental water diversions. Engineers are dusting off old proposals to re-route water from northern rivers to the dry centre of the continent.

Such plans would turn rivers into giant canals, demand huge amounts of energy and have serious ecological and climatological effects. Fresh waters flowing into the seas maintain a balance of nutrients and water conditions for aquatic life. They also maintain a climate balance. The 1988 report of the Science Council of Canada, *Water 2020*, said that, "depriving Arctic waters of as little as five per cent of their supply of fresh water could warm the Arctic and trigger climatic changes over a wide area, possibly on a global scale." Scientists also note that a constant flow of fresh river water is essential for the balance of life in the coastal areas of the seas.

Canada and the United States have also been put on notice that they must guard against excessive withdrawals of Great Lakes water. In 1985 the International Joint Commission, a body that advises both nations on boundary water issues, warned of "a potential for dispute and conflict" over the right to Great Lakes water in the future. The IJC said the two nations should take special precautions to avoid letting the consumption of water increase to the point that it reduces lake levels.

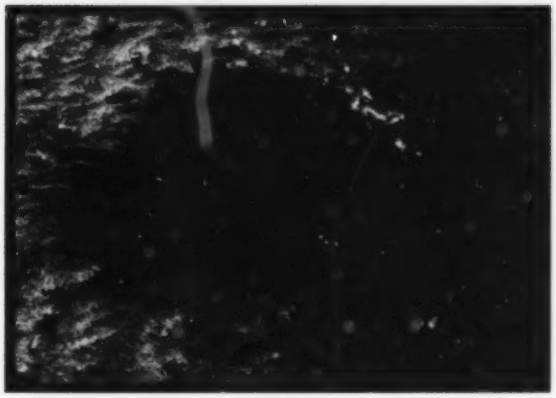


Even now the shape of our rivers is changing dramatically because of dams. The nation was explored by people in canoes, and part of the myth of Canada is that we are a land of wild, free-flowing rivers. But according to a Parks Service wild rivers survey, 86 of the country's 178 major rivers have been dammed for hydroelectric power, flood control or irrigation. The dam-building continues, with huge works proposed or under construction in Quebec, British Columbia, Alberta, Saskatchewan and Manitoba.

The Seas

The oceans cover more than 70 per cent of the planet and, although they play a critical role in maintaining the world's oxygen balance, moderating its climate and providing food, they have been treated as the ultimate dumping ground.

More than 95 per cent of the marine fish harvest comes from near-shore regions, yet these areas are under an increasing load of pollution and becoming less and less suitable for breeding. In 1988 there were massive algae blooms off the east coast of the United States and the shores of Norway, Sweden and Denmark. A large number of deaths among fish, dolphins, whales and seals has provoked a public outcry against the fouling of the seas. And people along the east coast of the United States were shocked by the sight of medical wastes washed up on their seashores.



Life in the oceans is also threatened by plastic garbage. The world produces 158 million tonnes of plastics a year, and a dangerous amount ends up in the seas. About 80 per cent of wastes found in oceans are plastic and they choke, strangle or poison an estimated 100,000 marine mammals and hundreds of thousands of seabirds a year. Plastic garbage, including disposable cigarette lighters, plates, cups, garbage can lids and bottles, is turning up on the most remote beaches on the planet.

As marine life is reduced by pollution, overfishing and over-hunting, the competition between nations for the harvest is escalating. It has got to the point of nasty international confrontations, including the use of Canadian fishery patrols armed with machine guns.

CHEMICALS, WASTES AND GARBAGE

Modern industrial development is based on the consumption and the rapid disposal of goods so more can be bought. The problem is that we are running out of places to throw things. The Earth can not biodegrade things as fast as we dispose of them.

As a result we hear of garbage barges and ships laden with toxic wastes cruising for thousands of kilometres in a vain search for disposal sites. Across Canada one neighborhood after another is saying no to requests for new dumpsites. People know that dumps often attract rats, flies, gulls and a steady stream of heavy trucks. Dumps also leak both smelly and potentially hazardous gases and release chemicals into underground water supplies.

Meanwhile, the amount of garbage produced in the country keeps on growing. On average we each dispose of a kilogram of refuse per day, an amount that rises to 1.7 kilograms when you add in the contribution from business. Across Canada the result is 42,500 tonnes per day or 30 million tonnes a year and rising. There are 10,000 active and closed dumps across the country, holes that everyone uses or has used but no one wants. There are also 15 garbage incinerators, all of which release at least some hazardous chemicals from their smokestacks and in their ash.

Chemical wastes are another part of the problem. There are about 100,000 commercial chemicals in the world and the number is growing by 1,000 to 2,000 a year. About 30,000 commercial chemicals are in use in Canada. These include about 25,000 tonnes of polychlorinated biphenyls (PCBs) either in use or awaiting disposal and another 15,000 tonnes that have been lost into the environment.

There are some 325 to 375 million tonnes of hazardous waste created globally each year. Canada produces an estimated 1.5 million tonnes of that total. Even household waste can be toxic. Each person throws out about 23 kilograms a year of hazardous materials, including batteries, paints and cleaning solvents.

And there are huge amounts of industrial waste which, though not highly toxic, are damaging the environment. For example, there are

about 150 square kilometres of mine tailings, mainly in British Columbia, Manitoba, Ontario, Quebec and New Brunswick. They react with water and bacteria to form acids that destroy life in nearby waterways. The president of the Canadian Mining Association estimated that it could cost $3 billion over 20 years to stop the leaching.

Canada has 12,000 tonnes of highly radioactive spent nuclear fuel sitting in storage at 19 nuclear power plants. In addition there are 120 million tonnes of low-level radioactive waste lying on the ground, mostly near the uranium mining centre of Elliot Lake, Ontario, but also near a major processing mill at Port Hope on Lake Ontario.

No one knows how many hazardous chemical dumps there are but new ones keep cropping up all the time and the bill keeps rising.

It will cost an estimated $50 million to clean up the Sydney tar ponds in Cape Breton, contaminated with wastes from years of steelmaking. The cost of controlling PCBs leaking from a storage site near Smithville, in the Niagara area, is almost identical. This makes these sites among the most expensive clean-ups on the continent. The PCB fire in Saint-Basile-le-Grand east of Montreal in 1988 forced the evacuation of 3,500 people. This incident will cost as much as $30 million in clean-up and compensation to displaced people.

In the United States, dumps such as the Love Canal, along the Niagara River, have become international symbols of the problems of chemical waste. The four biggest dumps hold enough hazardous waste to fill a line of 10,000 tanker trucks. Their leaking wastes threaten the drinking water for seven million Canadians and one million Americans downstream as far as the St. Lawrence River.

The bill to clean up such dumps will be staggering. Two federal U.S. agencies have estimated that cleaning up more than 10,000 hazardous dumps will cost from $11 billion to $100 billion. A third agency, the Office of Technology Assessment, says that the true cost to the nation will be several hundred billion dollars over the next 50 years.

CHANGING LIFE ON EARTH

As humankind pushes back the forests and marshes of the world it destroys the habitat for other species and changes the conditions under which life has evolved in the world. We are destroying species faster than they can be counted. Biologists have catalogued 1.7 million species of life, including plants, insects, fish, reptiles, animals and birds and estimate that there are 10-30 million more. Most are waiting to be discovered in the tropical forests, the green band of trees, vines and swamps that girdles the equator.

But the rapid loss of tropical forests is leading to the loss of an estimated 1,000 to 10,000 species a year. The Brundtland Report calls it "the greatest setback to life's abundance and diversity since life first emerged over 3.5 billion years ago."

In Canada, 165 species of mammals, birds, fish and plants were listed as endangered in 1988, including nine that are now extinct. The passenger pigeon, sea mink and Dawson caribou are gone forever. A host of other plants and animals are facing the slide into oblivion, including the beluga whales of the St. Lawrence estuary, Acadian whitefish, Eskimo curlew and Eastern cougar.

Despite some victories, such as the removal of the white pelican from the endangered species list in 1987, the list grows longer every year. And this list is far from complete because population data have not been collected for some species.

There is another, less often talked-about extinction taking place in the wilderness – that of human lives and aboriginal lifestyles. These lifestyles are being altered by the arrival of an industrial society in boats, helicopters and bulldozers. Some people are concerned about the arbitrary changes brought into other cultures. Others, including medical scientists, worry that the loss of aboriginal lifestyles leads to the loss of age-old knowledge about the medicinal uses of plants.

There are ethical questions as to whether we have a right to destroy other forms of life. There are also aesthetic questions because we enjoy the sight and sound of other creatures. And there are fundamental questions of self-interest. Our food supply and many of our medicines are based upon wild species and depend upon them for periodic injections of strong genetic material. When we breed some of our food crops to be more productive or to be easier to store and handle we sometimes breed out resistance to pests. These survival qualities, which kept the species alive over millennia, still reside in the wild plant stock. If we destroy the wild plants and animals we reduce our own food and medical security.

For example a leukemia-fighting drug from the small rosy periwinkle in Madagascar saves many children from leukemia and nets $100 million (U.S.) a year for the drug industry.

The fight against pollution is clearly a fight for human health. Chemical experts say we are all carrying pollutants in our fat cells. "The adipose tissue of all Canadians has become a rich repository of fat-soluble environmental contaminants, including large numbers of pesticides, flame retardants and industrial transformer fluids," says a report by noted researchers Donald Chant and Ross Hume Hall.

Toxic chemicals are known to cause cancer, loss of fertility, birth defects, blood disorders, mutations of cells and genetic damage, thus affecting future generations. They can disturb the central nervous system, attack a large number of the organs and have psychological effects. One substance may not be a strong carcinogen itself but may promote the formation of tumors by another chemical. Chemicals can also suppress or overload the body's immune system, rendering us vulnerable to diseases not normally related to chemical poisoning.

Experience shows that there will be a variety of individual reactions to any substance, depending on exposure levels and individual sensitivity. Most people are not allergic to pollen but some endure runny noses during the hayfever season. Most of us do not notice our daily dose of pollution while a few suffer from what is called environmental hypersensitivity or the twentieth-century disease. These people, whose immune systems have been diminished, must live in special homes and eat chemical-free food.

Toxicology and epidemiology are hard pressed to give accurate estimates of the health effects caused by pollution. As a result a growing number of people are doing their own risk assessments, as shown by the dramatic surge in the sales of organic foods, bottled water and water filters of recent years. Public opinion polls show that 93 per cent of Canadians believe environmental contaminants are damaging their health and 89 per cent feel their health has already been affected by pollution.

It is clear that this grim list of environmental problems is not the handiwork of a few criminals or some accidents. It is the result of many business practices and personal choices that we have considered normal for years, even centuries. Now the scale of human activity is so huge that many of the side effects are no longer tolerable. If we continue ecologically abusive forms of development, we will end up with a world that is not only unpleasant and unhealthy to live in but one that will be economically less productive.

To see the future we are creating, we have only to look at the growing number of polluted cities, slime-covered beaches, overflowing garbage dumps, spreading deserts and withering forests. Some people feel the future will be grim. Albert Schweitzer once wrote, "Man has lost the capacity to foresee and to forestall. He will end by destroying the earth."

But other people point out that humans are a highly adaptable species, with the capacity to foresee and avoid disaster. The section that follows offers suggestions from environmental and political experts about how we can change, and cites examples of how changes are being made but have to be accelerated. They talk about achieving a sustainable lifestyle, one which will bring stability to the biosphere. To achieve that we must find sustainable forms of development at all levels, from the way we run our households to how we run our biggest industries.

SECTION II

BEYOND PANIC

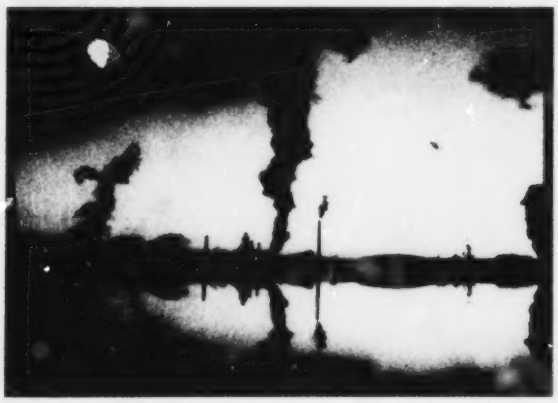
THE NEW ENVIRONMENT-ECONOMY AGENDA OF SUSTAINABLE DEVELOPMENT

"We make our environments," said Winston Churchill, "and then they make us."

Churchill was speaking about reconstructing the shattered buildings of England after the Second World War. We face choices about reconstructing our environmentally damaged world. We are now unmaking the natural environment through the cutting and burning of forests, damming of rivers, spreading of cities, elimination of other species and the injection of billions of tonnes of pollutants a year into the air, soil and water. If we want to arrest ecological damage and to preserve some major natural areas we will have to change much of our style of development. The goal is not to stop doing business but to start doing it in a way which will guarantee an environment that supports human life.

Environment experts often say this means linking environmental realities and economic decision-making. In 1985 the Royal Commission on the Economic Union and Development Prospects for Canada, headed by former finance minister Donald S. Macdonald, said: "It will be essential in the decades ahead to integrate environmental decisions and economic decisions for there is... no ultimate conflict between economic development and the preservation and the enhancement of a healthy environment and a sustainable resource base."

In 1987 a similar message came from the World Commission on Environment and Development, known as the Brundtland Commission, which called for "sustainable development." The same message came a year later from Canada's National Task Force on Environment and Economy, a group of environment and business leaders. It was adopted by Canada's prime minister and premiers and a growing number of business experts.



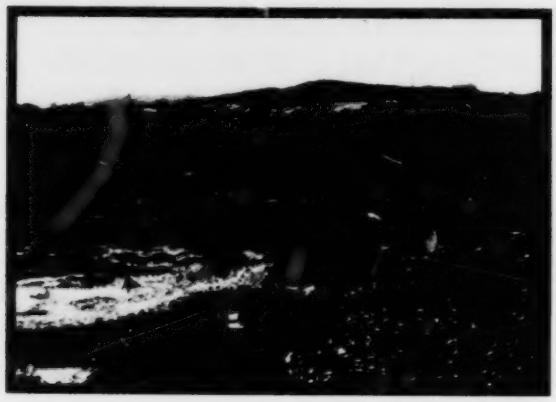
Sustainable development does not call for an industrial shutdown. In such a deeply interconnected and interdependent world any attempts to suddenly roll back the clock to the era of sail and horsepower would result in chaos. In fact the planet is committed to dramatic population growth over the next few decades and this will fuel an increased consumer demand. The Brundtland Commission estimated the world could face a five- to ten-fold increase in economic activity over the next 50 years to meet the needs and desires of a population of 10 billion plus.

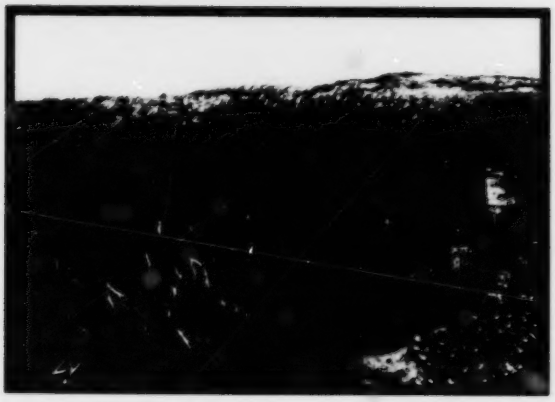
To meet the needs of today's world, where four out of five people are poor, plus the requirements of the next generation, the Brundtland Report said we will need "a new era of economic growth." The chairman, Norwegian Prime Minister Gro Brundtland, said, "economic growth is the only feasible weapon in the fight against poverty. And only economic growth can create the capacity to solve environmental problems."

But it cannot be the kind of economic growth which has created today's environmental problems. If development in the future is to be environmentally sustainable it must not create wastes faster than nature can absorb them, cannot discharge persistent toxins into the environment and has to live within the natural regeneration rates of renewable resources. As the Brundtland Report said, "At a minimum, sustainable development must not endanger the natural systems that support life on earth: the waters, the soils and the living beings."

It will mean major changes in many of the things we now take for granted.

If we are to start living in rather than treading upon the biosphere we must use sustainable forms of energy, transportation, farming, forestry, fisheries, mining, smelting, petroleum and chemical manufacture. On both a business and a personal level this implies lower consumption of most if not all raw materials and energy per person and per unit of production. This likely means a trend to different forms of consumption





A burned-out and polluted swamp near the smelter complex in Falconbridge, Ontario, (top) has been reclaimed as a conservation area.

including a move away from machines which demand huge amounts of energy, and a reduction in throwaway products.

Only with major change can we guarantee ourselves such basic needs as fresh water, clean air, good food, shelter, sanitation, health care, energy and jobs into the decades and centuries ahead.

To accomplish change we will need commitments to serious long-term planning by governments and businesses at the local, regional, national and international levels. One barrier to change is that people can still profit from actions that pollute and use up natural resources. This temptation is abetted by short-term business practices and political decisions of which the goals are often measured in cash rather than ecological stability.

In order to encourage individuals, companies and government agencies to switch to sustainable options we will need some sticks and a lot of carrots. Governments, pushed by an already anxious public, are increasing the penalties for pollution. But they have yet to come up with a wide range of incentives that would make it cheaper for businesses and individuals to be clean and efficient rather than dirty and wasteful. And governments need to provide more information that would help people make choices that are more sustainable.

There are signs of a major political shift developing in favor of environmental protection. The level of response from senior politicians in 1988 was unprecedented. For the first time in history, world leaders are saying that environmental protection is a prerequisite to continued prosperity and security.

- Prime Minister Brian Mulroney said: "The world is coming to realize that economic development and environmental protection are mutually reinforcing, not mutually exclusive."

- British Prime Minister Margaret Thatcher said that prosperity requires that nature be "nurtured and safeguarded." She went on to say that "protecting the balance of nature is one of the greatest challenges of the 20th century."

- Finance Minister Michael Wilson said: "Environmentally sound development is no contradiction in terms. Indeed in the long run it may be the only sure foundation of better lives for everybody in the world."

- Barber Conable, president of the World Bank, attacked "the moral outrage" of poverty, adding, "we have a collective responsibility to break this vicious cycle of poverty and environmental degradation."

- Soviet Foreign Minister Eduard Shevardnadze said that threats to the environment rival the nuclear menace. "The biosphere recognizes no division into blocs, alliances or systems," he added. "All share the same climatic system and no one is in a position to build his own isolated and independent line of environmental defence." Mr. Shevardnadze said money from arms spending should be diverted into environmental protection.

While these are only statements of intent they are the necessary precursors to action.

DEFINING SUSTAINABILITY

What is this ideal of sustainability and how is it supposed to work? The goal is clearly sustainable ways of living that operate at a global level. The process of getting there is called sustainable development. Canada's National Task Force on Environment and Economy says it is "development which ensures that the utilization of resources and the environment today does not damage prospects for their use by future generations."

The concept is both very simple and very complex. It is simple because we obviously cannot continue to foul our own nest on this planet and expect to live comfortably. It is complex because to arrest the downhill slide we are going to have to make significant changes in business practices and individual behaviour. We have to keep developing but we must stop cutting too many trees, over-farming the land, catching too many fish and using too much coal, oil and underground water supplies.

What kinds of economic activities are sustainable and which ones must be changed or abandoned? Neither the Brundtland nor the National Task Force reports spells out a blueprint for economic change. At the 1988 Toronto conference on protecting the atmosphere Dr. Brundtland said that governments must adopt "a new political approach to environment and development, where economic and fiscal policies, trade and foreign policies, energy, agriculture, industry and other sectoral policies all aim to induce development that is not only economically but ecologically sustainable."

Maurice Strong, an environmentalist, industrialist and member of the Brundtland Commission, has said, "sustainable development is good business. If a business does not continuously renew its plant, equipment and the resource base on which its profit depends, it simply runs down." He suggests that business should focus on using small amounts of energy and raw materials to create high-value products and cites telecommunications and similar high-technology equipment as examples.

EVOLUTION OF THE SUSTAINABLE DEVELOPMENT CONCEPT

The warnings of limits to unfettered demands on the biosphere are not new. In 1798 the English political economist Thomas Malthus predicted that population growth could not continue forever or populations would outstrip available natural resources.

In 1915 Canada's Commission on Conservation wrote about the need to live within natural cycles by saying: "Each generation is entitled to the interest on the natural capital, but the principal should be handed on unimpaired."

In 1972 the United Nations Conference on the Human Environment, in Stockholm, declared, "The capacity of the earth to produce vital renewable resources must be maintained and, wherever practicable, restored or improved."

The same year the Club of Rome, a gathering of world scientists, educators, economists, humanists, industrialists and civil servants, issued its now famous book, *The Limits to Growth*. It said fresh water, arable land, forests, minerals and the oceans are "the ultimate determinants of the limits to growth on this earth" and those limits were coming into sight.

In 1973 the Science Council of Canada added another term to our lexicon with the phrase, "conserver society." It said that, "Canadians, as individuals, and their governments, institutions and industries, [must] begin the transition from a consumer society preoccupied with resource exploitation to a conserver society engaged in more constructive endeavours."

The 1980 World Conservation Strategy, prepared by the International Union for the Conservation of Nature along with the United Nations Environment Programme and the World Wildlife Fund, promoted the idea of environmental protection in the self-interest of the human species. It warned that the destruction of natural resources eliminated future sources of food, medicines and industrial products.

But it was the Brundtland Commission that lit a fire under the issue. The commission was created by the United Nations after a number of nations, including Canada, pushed in the early 1980s for a study of the future of the environment. The commission was announced in 1983 and began work the following year.

It was headed by Dr. Brundtland, a former Norwegian environment minister who went from leader of the opposition to prime minister during her work with the commission. The 22 members of the group came from 21 nations, rich and poor, north and south, east and west. Maurice Strong, a commission member, and James MacNeill, its secretary-general, are both Canadians. The commission held hearings around the world before issuing a final report, *Our Common Future*, in April 1987.

Its ideas found fertile ground in Canada. After meeting with the Brundtland Commission, the Canadian Council of Resource and Environment Ministers formed a 17-member National Task Force on Environment and Economy. It included environment ministers, business executives, environmentalists and academics.

A year later the task force issued a tersely worded but sweeping report summed up in the phrase: "Change is necessary and it must occur now." It said that "long-term economic growth depends on a healthy environment" and "environmental considerations cannot be an add-on, an afterthought. They must be made integral to economic policy making and planning and a required element of any economic development proposal."

The report added, "The development of a clean industrial technology will be essential," and it called for new processes and techniques that make less use of hazardous materials.

It was a historic statement, not just for what it said, but for who said it. "For the first time you had corporate leaders, environment ministers and environment groups focusing on common areas where they can make progress together," said task force member David Buzzelli, chairman of Dow Chemical Canada, Inc.

In all, the group made 40 recommendations ranging from the need for research on how to run an economy without running down the environment to the provision of more information about the environment.

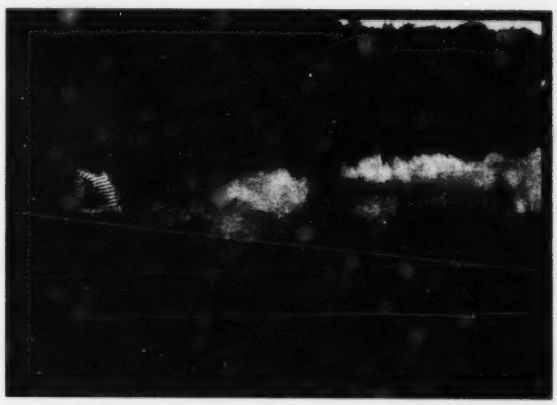
The recommendations included:

- publicizing the value of our natural resources – including the water, soil and forests – so that people will treat them with more respect;
- giving environmental performance awards and rewards, including tax credits for companies that exceed standards;
- increasing recycling and improving waste disposal;
- developing education programs so that the next generation will be better able to avoid environmental pitfalls;
- opening up decision-making to include government, industry and non-government organizations;
- doing a better job of measuring change in the environment;
- developing business task forces on environment-economy linkages and the creation of environmental principles and policy guidelines for companies;
- creating demonstration projects to show how to implement the environment-economy linkage in such areas as forest, water and soil management and climate change.

The task force, a temporary body, put the onus for change on the nation's political and business leaders. It said the prime minister, premiers and territorial leaders must take responsibility for leading change. The report suggested they appoint ongoing round tables on environment and economy across Canada to provide advice on the kind of changes that are necessary.

These round tables are to include senior decision-makers from government, industry, environment organizations, labour, academia and aboriginal peoples. One of the most important tasks of the round tables will be to act as a clearing house for ideas about the priorities and techniques for change. These groups can both collect the information from people across the nation and disseminate it back out to a wider audience.

The members of round tables are expected to lead public opinion and to implement change within their own departments, corporations and organizations.



Most provinces and territories have indicated an interest in creating such advisory groups. By early 1989 Quebec, Nova Scotia, Manitoba, Ontario, Prince Edward Island, New Brunswick and Saskatchewan had created round tables and the federal government had formed a national round table.

The task force said that business leaders have a responsibility not only to protect the environment but to help each other with the job. It suggested the Canadian Chamber of Commerce and the Business Council on National Issues create environment-economy task forces, a recommendation which has been adopted.

And the task force called for greater public involvement in the debate about the future of the environment. It said citizens should have a greater say in developments that will affect their environment.

People know the environment is in trouble now, so the task force called for projects to demonstrate sustainable development in action. In mid-1988 Quebec said it would make its demonstration project the restoration of a healthier St. Lawrence River. The province created a 38-member team drawn from government, industry, universities and public interest groups to define a program for economic development and environmental restoration of the river. Ottawa will contribute $110 million toward the work, which will cost an estimated $3 billion.

The task force called for conservation strategies in every province and territory by 1992 to "ensure that we preserve genetic diversity and maintain essential ecological processes and life support systems." These strategies are more than plans for the preservation of nature. The task force says they are to be "blueprints for sustainable development" and "frameworks for the judicious use of our renewable resources." They are to be linked together by a national strategy and should mesh with similar plans in the rest of the world.

While no single document will be able to deal with all the complex issues in sustainable development, a strategy will be helpful in laying out common problems, goals and solutions. This will help to avoid the current fragmentation of ideas and efforts among different industries, governments and even departments within governments.

Among the objectives listed in various conservation strategies now being developed by governments and independent groups in Canada are:

- the maintenance of ecological processes and life-support systems, including ecological succession, soil regeneration and protection, the recycling of nutrients and the cleansing of air and water;
- the preservation of biological diversity, which forms the basis of life on earth and assures our foods, many medicines and industrial products;
- the sustainable use of ecosystems and species such as fish, wildlife, forests, agricultural soils and grazing lands so that harvests do not exceed rates of regeneration required to meet future needs;
- the use of non-renewable resources in a manner that will lead to an economy that is sustainable in the long term. This means the development of renewable substitutes.

Prince Edward Island, which faces serious problems of soil erosion and pollution of underground water resources, was the first province to adopt a conservation strategy. Its aims include soil and water conservation, pollution control, better wildlife management, landscape protection and coastal zone management. It calls for a reduction in erosion by changing farming practices, modifying road construction and planting more trees along stream banks.

The Yukon and Northwest Territories have said they expect conservation strategies will be ready in 1989 while other provincial strategies are due in the next few years.

ELEMENTS OF SUSTAINABLE DEVELOPMENT

Although we have yet to develop a clear picture of how to live and do business sustainably, there are some obvious pathways to follow.

Economic activity can advance sustainability by :

- reducing per capita consumption of energy and resources;
- reducing energy and resource content per unit of output;
- reducing waste discharges per unit of output and in total;
- decreasing wastage of natural resources during harvesting and processing, thus increasing the amount put to productive use.

Resource Accounting

In order to do business differently we will have to broaden our notions of accounting to include measures of how business activities might affect sustainability.

We now rely heavily on the Gross National Product (GNP), the market value of all goods and services a nation produces in a year, to measure economic progress. However this barometer does not measure the quality of change. Even if economic activity produces a lot of pollution and reduces the resource base while making money, the GNP still goes up.

The Macdonald Commission understood this when it quoted with approval a comment from the Saskatchewan Environmental Society: "The Gross National Product is, in a sense, a false measure of how far ahead we have been able to get, because it does not take into account such things as depleted soils and the cost of restoring them [or] contaminated food chains and the health effects." The commission added, "Greater consideration should be given to the development of a combined social and economic accounting system that covers not only the conventional economic indicators but also such matters as soil depletion, forest degeneration, the costs of restoring a damaged environment and the effects of economic activity on health."

People have suggested such terms as a Gross Ecological Product, Gross Ecological Debt and the margin of sustainability. These would measure not only the money flowing through the business cycle but how much raw material and energy were being used and how much were being replaced by nature with or without human assistance.

There will be no simple yardstick, because living systems are complex and interrelated. Evolution shows that the natural tendency of the planet has been to produce more species of life. As a result we must take into account not only the status quo but the ability of life forms to keep diversifying.

There are some simple tests for sustainability, including:

- the amount of arable land and forest that is being lost;
- the amount of silt in rivers coming from eroded farm fields;
- the loss of large numbers and even whole species of wildlife;
- the positive or negative impact of processes and products on the health of living things;
- the impact of development on the stock of non-renewable resources such as oil, gas, coal, metals and minerals;
- the effect on the cycle of renewable resources such as water, food and forest products;
- the impact of waste products;
- the ability of new proposals to implement cleaner and more resource-efficient techniques and technologies.

THE MAJOR SECTORS
SAVING THE ATMOSPHERE

Over the past few years the threats to our atmosphere have become a focal point for public concern about the environment. Acid rain, heavy metals, oxidants and toxic chemicals in the air are a threat to the health of many forms of life. The thinning ozone layer raises the risk of more illness and crop losses, while climate change brings the likelihood of major upheavals in weather, food production, forests, water supply and settlement patterns.

The control of air pollutants poses a major challenge to the world because they are the waste products of basic industries and energy sources, including those that power virtually all our transportation systems.

Canada has started an acid rain control program aimed at lowering acid fallout from domestic sources to levels that most of the environment can tolerate. It will cost about $500 million a year just to cut in half by 1994 the amount of sulphur dioxide that creates sulphuric acid rain. Millions of dollars more must be spent to reduce the nitrogen oxides that come from motor vehicles and industries. But because acid rain is a continental issue, Canada's problem will not be solved until there are corresponding pollution controls in the United States.

At a conference in Montreal in 1987 Canada and 23 other nations signed an agreement to cut world production of ozone-eating chlorofluorocarbons (CFCs) by half by 1999. In 1989 Environment Minister Lucien Bouchard announced that he wants CFC use eliminated in Canada within a decade. It is relatively easy to replace these chemicals with safer alternatives in aerosol cans and even in most foam plastics. But it will be much harder to replace them in our refrigerators and air conditioners. The chemical industry hopes to have safer materials available in a few years. Right now we face the huge task of preventing the millions of tonnes of CFCs now in use around the world from escaping into the sky.

Despite scientific pleas for actions to cut carbon dioxide emissions in half to stop the greenhouse effect there are no such national or international programs. Canada and other nations that produce a lot of this gas still have to make decisions about how much CO_2 they plan to cut and over what time frame.

In order to weave together a growing series of air protection plans and laws the Toronto Conference on The Changing Atmosphere suggested that nations forge an international plan to save the atmosphere. It called for a global law of the atmosphere.

The conference called for policies to reduce greenhouse gases by promoting energy-efficiency programs which would reduce the need for carbon-based fuels. It proposed a World Atmosphere Fund, based partly on a levy on fossil fuel consumption by industrialized nations to help developing nations build clean industries and to protect their forests. There has been increasing pressure on rich nations to forgive more of the Third World debts, which by early 1989 totalled more than $1.3 trillion (U.S.). There are suggestions this would be an incentive to poor nations to conserve and regrow tropical forests, which soak up carbon dioxide and release oxygen.

In the case of other air pollutants, including toxic organic chemicals, no one has yet estimated the total amount of discharges or the cost of controls. Some governments, for example Ontario, are starting to demand that industries monitor and subsequently reduce the amounts of pollution that they release into the air and water.

SAVING THE LAND

The massive expansion of cities, farms, ranches and logging operations have dramatically altered the thin skin of soil and plant life that make the planet habitable for humans. Sustainable development must reverse that trend with a land strategy to save farmland, forests, wetlands, grasslands, tundra and other valuable areas.

Preserving farmland is an obvious priority in a world which already has too many hungry mouths and is adding more every day. Canada is in no danger of running out of food but we have an economic incentive to maintain a food business that supports 293,000 farms and 1.7 million jobs.

Any strategy to protect lands must look at how government, bank and business policies steer farm practices. We have our own debt problems which encourage land degradation. Fluctuations in food and land prices in recent years pushed thousands of farmers into or over the edge of bankruptcy. Pressure for quick cash pushed many farmers to till every bit of land and this is leading to more soil depletion, water pollution and the loss of wildlife habitat.

Even crop insurance policies can contribute to ecologically unsound farming. Since farmers are paid for the amount of land that is seeded but which fails to produce a crop, there is an incentive to plow areas that should be preserved for wildlife or water retention.

In other countries food production is a serious issue. A number of food experts say that although there are food surpluses in the world we do not produce enough of the right kinds of food to feed the planet properly. About 730 million people are currently undernourished, and millions more are being added to the list each year.

The demand for food is going to grow dramatically in the coming years. In 1986 the world produced 1.9 billion tonnes of food grains for a population of 5 billion, but by 2025 it will have to produce over 3 billion tonnes to feed more than 8 billion people. On a regional level this means that Africa will have to increase grain production fivefold and Latin America needs a threefold gain.

The physical ability of the planet to produce food will determine how many people can live on Earth. There are estimates that between 8 and 11 billion could be supported, depending on how much food each got. However, many experts point out that even current forms of agricultural production are contaminating, waterlogging or eroding soil, thus reducing future prospects for food production.

While food aid from nations like Canada acts as a lifesaver to starving people, it is not the long-term solution to feeding the growing world. It is very difficult and costly to keep transporting huge amounts of food around the planet on a continuing basis. Countries, or at least regions, have to become largely self-sufficient in food, and this will require policies that encourage the growing of food for domestic markets. Many people now go hungry while their countries export food and commodities such as coffee to pay foreign debts.

In order to stop losing soils we must encourage better farming practices, many of them known for millennia. Windbreaks, terraces, contour plowing, crop rotation and the maintenance of crop residues on the land are classic ways to hold soil. But they have often been discarded in the rush for short-term profits.

Stubble mulching to improve soil quality

Irrigation boosts short-term crop production but too often leads to long-term soil damage and uses up limited water supplies. Heavy farm equipment is causing soils to be packed too hard for good farming and the excessive use of chemicals is polluting soils and water supplies.

Pesticides are a two-edged sword for agriculture. They are used to kill creatures that prey on crops but the chemical residues sometimes have

severe side effects, including the poisoning of wildlife that we value and the contamination of drinking water. Pesticides are not going to vanish suddenly but they are changing. Some of the more persistent and toxic compounds have been banned and others are under close scrutiny. In their place people are using less hazardous products, including relatively benign insecticidal soaps. Pest control experts are also focussing more attention on artificially bred natural predators that attack insect pests and on farming techniques that naturally discourage pests.

Trees are the other big crop at risk. Canada is a forest superpower: first in exports, second in forested area and third in forest products. Our forest industries ship $30 billion a year in goods, employ nearly 300,000 Canadians and form the mainstay of 300 single-industry communities.

A large part of Canada's fortunes have been built on forestry but the country has been slow to protect this asset. As Sir John A. Macdonald watched an endless stream of logs flowing down the Ottawa River in 1871, he wrote: "We are recklessly destroying the timber of Canada and there is scarcely a possibility of replacing it... It occurs to me that the subject should be looked in the face and some efforts made for the preservation of our timber."

Until recently about one-third of the forests cut in Canada were replanted, one-third regrew satisfactorily after cutting and one-third regrew trees that the industry was not equipped to use. This has meant that companies are forced to keep driving further and paying more to get the wood they need. Les Reed, a Vancouver forest economist and former head of the Canadian Forestry Service, says that wood companies could run forever if they planted and tended forests within a 100-kilometre radius of their mills.

A National Forest Sector Strategy adopted by the Canadian Council of Forest Ministers in 1987 adopts the new environmental agenda by saying that forest management must meet the requirements of sustainable development. It says the wood business must maintain healthy, stable and well-balanced forest systems and co-operate with wildlife managers. The strategy says that pest management programs, including those which use chemicals to kill insects and some tree species, must be ecologically and economically justified.

Sustainable forestry has to include getting more value out of the wood that is growing now. This means wasting less of the trees that are cut and making better use of what are now considered non-commercial tree species.

The forest industry faces serious questions about its old practices. One of the most controversial is clear-cutting, which involves cutting down all the trees in a large tract. This creates unsightly scars on the landscape and leads to soil erosion causing the pollution of nearby streams and rivers, the fouling of fish habitat and the siltation of downstream dams and harbors. Clear-cutting is often followed by the use of herbicides to kill broad-leafed hardwood trees so that commercially desirable coniferous softwoods can grow more easily in cut-over areas.

Pulp mills are coming under close scrutiny following revelations that they discharge large amounts of chemical pollution and that some paper products contain traces of toxic chemicals known as dioxins.

A program of reforestation is a worldwide priority. The dramatic shrinkage of the forests and the simultaneous spread of deserts can be stopped by an aggressive program of forest protection combined with tree planting. Some areas should be preserved to maintain the age-old evolutionary process. Others can be harvested but must be replanted, while now-degraded forests need to be reclaimed. Dr. Brundtland said the world needs to plant trees on an area the size of Saskatchewan every year.

There are some encouraging signs. In China and South Korea, massive tree replanting efforts have covered thousands of square kilometres with fast-growing pines. India, faced with serious floods caused by deforestation in the foothills of the Himalayas, is encouraging local residents to adopt and guard forests from tree poachers. Some citizens are known as tree huggers because they will put themselves between trees and people who try to cut them. In Brazil

many rubber tappers are trying to preserve their way of life by preventing the cutting of their forests. In parts of the Sahara a green dam of vegetation has been planted in an effort to stop the advance of the sands.

While political and financial leaders debate how much Third World debt should be forgiven, some environment groups are taking action now. Organizations like the World Wildlife Fund use donations to buy some of the debt in return for tropical rain forests' being protected as parkland.

The battles to save forests draw much of the public attention but it is also important to save other valuable forms of habitat. Wetlands are the nurseries for many forms of life, including fish and waterfowl. They also act as natural water reservoirs and purification systems. But marshes, swamps and bogs are still often seen as wastelands and filled in or plowed under. In the future, development plans must allow for the preservation of enough wetlands to preserve wildlife and water quality.

The world's natural grasslands are also under siege as they are being converted to farmland. There will have to be some limits to farm expansion if we want to preserve remnants of what were once vast, natural ecosystems.

SAVING THE WATERS

The ability to protect water quality will be another test of our ability to live sustainably.

Millions of tonnes a year of wastes are dumped into Canadian waters and far greater amounts are dumped around the world and in the oceans. Hundreds of thousands of our lakes face acidification and large numbers of fish are unsafe to eat because they live in polluted waters. A growing number of underground water sources are polluted because of chemical spills or steady seepage from underground dumps, storage tanks and pipelines.

In order to protect water quality, people, cities and industries will have to reduce dramatically the amount of pollution they release. This will require major changes in industrial processes, anti-pollution equipment and controls on municipal sewer systems. It will mean implementation of promises made in the 1978 Canada-United States Great Lakes Water Quality Agreement, which called for no further discharges of persistent toxic substances. This principle underlies new water quality rules being implemented by Ontario.

To cope with the raw sewage still going into our waters we must build many more sewage treatment plants. At the same time we have to increase the efficiency of many existing sewage treatment systems, and reduce the amount of hazardous materials dumped into sewers by industries and citizens. These chemicals upset sewage treatment operations and expose their workers to hazardous fumes. And we need to encourage people not to use excessive amounts of water because this puts a heavy load on sewage systems. For example roof drains which now dump a heavy load of water into sewer mains could be redirected onto lawns. Storm water runoff from streets could be directed onto fields or ponds to soak into the ground rather than being funnelled into sewers at top speed.

Our decaying sewer and water systems need about $5 billion of repair work just to keep them from falling apart and spreading pollution. James McLaren, a Toronto engineer and member of Canada's federal water inquiry, said

Canadians should pay about 26 per cent more in water rates to raise the funds to do the job properly.

Farm irrigation is the biggest water consumer in Canada and around the world. Irrigation takes water and generally does not return it to the rivers. To avoid more water shortages, particularly in parts of western Canada and other farmlands, we must make irrigation systems more efficient. In classic irrigation systems that pour water down furrows between the crops, as much as half the liquid never reaches the plants. But equipment now exists to deliver up to 98 per cent of the water to irrigated crops. Using more of this equipment will dramatically reduce the quantity of water needed before climate change puts more pressure on water supplies.

The same principle holds true for industrial and home use where we could replace old equipment and fixtures with modern, water-efficient devices. This could reduce demand for water even as the population increases.

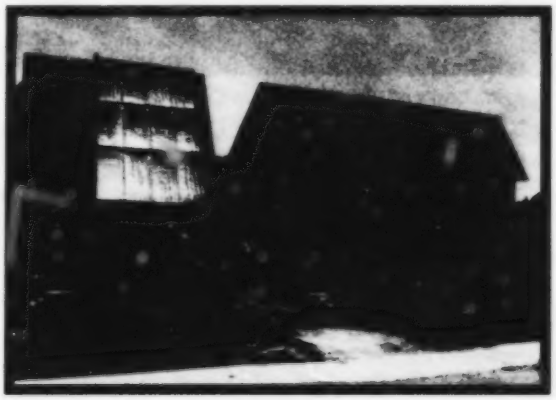
MAKING ENERGY SUSTAINABLE

The largest development changes facing industrial society will likely be in the energy field. The Brundtland Report says, "The ultimate limits to global development are perhaps determined by the availability of energy resources and by the biosphere's capacity to absorb the by-products of energy use."

The world faces the task of controlling between five and seven billion tonnes of carbon dioxide and 200 to 250 million tonnes of acid gases from our smokestacks, chimneys and tail pipes. These come from the fuels that we use to heat our homes, cook our food and power our industries.

In 1988 two major conferences warned that carbon dioxide had to be cut by half in order to arrest the climate warming. Experts at these meetings suggested a 20-per-cent cut by the year 2005 and a 50-per-cent cut by 2030, even though the world's energy demand is rising every year. About one quarter of the world now uses about three quarters of the energy generated. If everyone were to consume power at the rate in industrial nations, we would have to generate five times as much energy globally.

The Toronto atmosphere conference suggested that the world should start switching to low- or no-carbon fuels such as hydro-electricity, wind, solar power, natural gas, biomass and possibly nuclear energy, if it can be made safe and if its use does not lead to more nuclear weapons.



The Brundtland Report called for the transfer of clean, modern technology from the developed to the developing nations so they will not create the same kind of pollution as the industrialized nations.

The first tool to attack pollution from current energy sources is conservation and greater energy efficiency, which can effectively increase the amount of energy available without building new dams and power plants. Conservation can be as simple as switching off lights and appliances not really needed and using the minimum heating and cooling needed. An example of energy efficiency is the redesigning of cars over the past decade or so. Modern cars are 70-per-cent more fuel-efficient than those made before the 1973 oil embargo.

The idea of higher energy efficiency was strongly endorsed by the federal Energy Options Advisory Committee in its 1988 report, *Energy and Canadians into the 21st Century*. It said: "Energy efficiency is not simply 'conservation' with its Spartan connotations of lowered thermostats and restricted driving... Energy efficiency is about getting the same, or better, services from less energy by substituting ingenuity for brute force."

The committee added, "Minimizing energy use, where it is economic to do so, is a practical way to reduce the global problems of nuclear wastes, carbon dioxide and air pollutants." The report said that, using available technology, "current energy inputs in major energy-using sectors could be profitably lowered by 20 to 30 per cent without reducing the output of products and services."

According to Environment Canada's 1986 annual report on climate change, the world could reduce CO_2 emissions by 68 per cent by the year 2050. This would require major technological improvements to recapture heat that is now wasted, much higher fuel efficiency in transportation and better engineering of power stations.

In fact, many of the recommendations about energy conservation are not new. They have been promoted for decades but have been largely ignored in wealthy societies where the cost of energy has often been decreasing when compared to growing inflation. There was a surge of interest in energy conservation after the oil embargo of 1973, but that has not been pursued vigorously. Much of the information about energy conservation is gathering dust on the shelves awaiting a renewed public interest.

One of the problems is a megaproject approach to issues like energy. As Daniel Yergin, co-author of *Energy Future* for the Harvard Business School, noted, "It is easier for the government to organize itself to do one big thing, but, alas, that is not what productive conservation is about. It involves 50,000 or 50 million things, big, medium and little, and not in one centralized place."

Another impediment to change is the up-front cost. Energy-efficient equipment can be expensive to buy but energy is still relatively cheap. We have to find ways of encouraging investment in low-energy equipment, such as light bulbs that are 80-per-cent more energy-efficient than those commonly used, windows that are three times more efficient and refrigerators that are twice as efficient.

And we have to find ways to tap huge amounts of energy which are discharged as waste heat by industries. The energy can be harnessed with on-site generators in a process called co-generation and the electricity can be directed back into electricity systems. Some waste heat can be sold to nearby industries for use in manufacturing. The Ontario Hydro nuclear station in Bruce County, Ontario, is experimenting with the sale of "waste" heat to nearby greenhouses which can grow fresh food in the winter.

Part of the change ahead will require choices in fuels. For example, natural gas emits less CO_2 than oil and half as much as coal. On the other end of the scale, synthetic fuels made from coal

and oil shale give off more CO_2 than ordinary coal. There will be difficult choices to make. Hydro-electric power produces no air pollution but it dams free-flowing rivers, disrupts natural ecosystems downstream, and its reservoirs can lead to mercury leaching from the environment into fish. Nuclear power plants emit no acid gases or CO_2 but there are still questions about the safety and long-term reliability of nuclear reactors and the disposal of nuclear wastes.

Some relatively new technologies can add to the power stream. These include the development of more efficient solar panels, wind generators, geothermal and wave power as well as small-scale hydro-electric generators which tap the power of moving streams without requiring dams. Scientists are working on a technology called nuclear fusion, which does not produce radioactive wastes.

There are signs that the power producers see the need for change. Robert Franklin, president of Ontario Hydro, said in 1988 that the utility will spend $1.5 billion over the next 12 years to reduce the use of electricity plus another $1.3 billion to encourage private companies to generate their own power. Mr. Franklin said, "We are not emphasizing conservation for conservation's sake. It just makes good economic sense."

In 1988 the federal government announced that the Energy Efficiency and Diversity Initiative and the Energy Research and Development Program will put $600 million into energy research and development, conservation and oil substitution. A research centre in Varennes, near Montreal, will work on efficient heating systems, heat pumps, hydrogen, biomass fuels, solar and wind energy.

IMPROVING WASTE MANAGEMENT

With over 30 million tonnes a year of garbage going into its dumps Canada is rapidly running out of acceptable landfill sites. Cities like metropolitan Toronto periodically face disposal crises as surrounding areas become more and more reluctant to accept their wastes.

The first option is to minimize the creation of waste. Whatever waste remains should not be dumped in the air, land or water if possible. The alternatives to dumping, waiting in the wings for many years, are the four R's of waste management: recycling, re-use, recovery and reduction. Recycling is starting to catch on. Canadians have recycled less than one per cent of their garbage, but by early 1989 Ontario had distributed more than one million blue, household recycling boxes. Some municipalities have imposed mandatory recycling. Midland did this after the local dump was closed because of leaking toxic chemicals and the town's wastes had to be trucked to a landfill 100 kilometres away.

Curbside recycling can easily capture about 15 per cent of such household wastes as cans, bottles and newspapers. The take can be raised to at least 70 per cent or better through the addition of magazines, cardboard, plastics, textiles, wood and plant material, including food scraps and garden clippings. Homeowners can take the pressure off landfills by composting garden wastes, including leaves and grass cuttings, along with some food wastes. This creates a rich

organic fertilizer for gardening, which reduces the need for expensive chemical fertilizers.

Recycling not only prevents dumps from filling up but it saves energy and reduces the need for big mines and clear-cuts of forests. For example, it takes 95 per cent less energy to recycle aluminum than to smelt it from bauxite ore. Reusing a tonne of newsprint saves 20 mature softwood trees and prevents a lot of water pollution caused during the harvesting and processing of those trees.

Recycling aluminum cans

Industrial recycling has become big business. Reclaiming iron and steel scrap from two million cars plus millions of washers, dryers, stoves, refrigerators, old buildings, farm and mining equipment is a $1-billion-a-year enterprise in Canada.

It is also good business for firms of all sizes. *Profit from Pollution Prevention*, published by the Pollution Probe Foundation in 1982, records dozens of success stories in which waste was reduced and profits were raised. A newspaper that installed ink recycling equipment paid for the machinery in a few months and its savings grew as its bill for new ink dropped. An electroplating company installed a recycling system that catches 99 per cent of the chrome, nickel and copper. The equipment cost $400,000 but had a payback time of only two years.

Dow Chemical and Domtar Inc. have formed a joint venture to recycle discarded plastic for use in manufacturing. The new company will take plastic that would normally have gone into landfills and process it into plastic that can be used to make new products.

A process developed by Environment Canada engineers at the Wastewater Technology Centre in Burlington can turn sewage sludge into industrial-grade fuel oil. It could convert about 70 per cent of Canada's 500,000 tonnes a year of sewage sludge into 700,000 barrels of oil worth about $20 million. The first major installation will be in the new Halifax sewage plant. While the system is not an economical way to produce oil, it is a cheaper way to get rid of sludge than incineration and less harmful than dumping.

The role of biodegradable products is still under debate. Although some can break down in the presence of sunlight and others decay when buried in the soil, there are questions about some of the by-products of decay. Two of the products being used are Ecolyte, a plastic that is broken down by sunlight, and Ecostar, a plastic containing starch, that is attacked by micro-organisms in the soil.

But these are only starting points. In the long run we have to move away from a throwaway society because it goes counter to sustainability. Some disposable products may be acceptable, at least when they involve keeping food or medical products sterile. But the idea of making items like cameras disposable does not make a lot of sense in a society that is running out of space for dumping.

One area ripe for change is packaging. The Worldwatch Institute in Washington estimates that packaging in industrial nations creates half our household waste. A program to sharply reduce the amount of waste dumped would mean that existing landfills could last for many more years. In the final stages landfills should be used only for a few inert substances, such as clean building rubble that cannot be recycled.

Sorting plastic household waste for recycling

SAVING WILDLANDS AND WILDLIFE

Reducing toxic waste and saving wild lands and waters is an important part in the struggle to save wildlife. But preserving natural areas, particularly around the settled parts of the country, is going to be an uphill battle as cities, industries, mines, forestry operations and farms expand.

In Canada, the creation of parks has been a race against time and competing interests, particularly logging and mining. One of the most contentious environmental debates in recent years was resolved in 1987 with the creation of the South Moresby National Park Reserve off the coast of British Columbia. This protected one of the most rare and beautiful ecosystems in the world from further logging. Dozens of similar battles are being waged across the country over pockets of wilderness.

The preservation of some pure wilderness is vital but we can also keep other regions in a relatively wild state by limiting intrusion to roads and power lines. Such areas will not be totally wild and natural but they can still be habitat for wildlife and recreation areas for humans. Even a backyard can still provide some habitat for birds and small animals if it has some bushes or trees and is not heavily treated with chemicals.

Whooping crane

We do have a lot of endangered species but there are signs that this trend can be reversed. Possibly the best known success story is that of the whooping cranes. By 1941 there were only 16 of these regal, white birds but Canada and the United States protected and nursed the small flock back to health. By 1988 more than 160 wild birds were migrating, mainly between Wood Buffalo National Park and the Gulf of Mexico.

The peregrine falcon is another symbol of attempts to reverse environmental destruction. In eastern North America these birds, the fastest on earth, had virtually been wiped out by pesticides such as DDT in the food chain. In recent years Canada and the United States banned many of the worst pesticides and are now reintroducing birds like the peregrine and the bald eagle, another pesticide victim, into their former domain.

In 1987, for the first time a Canadian wildlife species facing extinction had recovered to the point that it could be taken off the danger list. The white pelican, a huge bird found mainly in western Canada, seemed destined to join the passenger pigeon. However, conservation programs, including those funded by World Wildlife Fund Canada and the Canada Life Assurance Company, educated people not to disturb the breeding birds.

One of the most ambitious projects to save wildlife habitat is the North American Waterfowl Management Plan. Over the next 15 years it will attempt to protect and improve more than 15,000 square kilometres of wetlands, mainly in the Prairies, but also in Ontario, Quebec, the Maritimes and parts of the United States. These are the key breeding grounds for the continent's ducks. Governments are looking to private sources to raise much of the estimated $1.5 billion needed. About $1 billion is targeted for the Canadian Prairies alone with three-quarters of that money to come from private U.S. sources.

IMPLICATIONS FOR GOVERNMENTS

We look to our governments for leadership. Now that environmental protection has become one of the most important public issues, there will be a great onus on governments to provide information and policies that encourage sustainable forms of development.

Until recently, governments generally treated the environment as just one more factor in decision-making rather than as the underpinning for all actions. As a result they have left the responsibility for environmental protection to environment departments which have traditionally been junior portfolios with relatively little clout at the cabinet table.

The National Task Force said that the Prime minister, premiers and territorial leaders must treat the environment portfolio as an important post. It said that the political leaders must personally take a leading role in promoting sustainable development and must hold all cabinet ministers and their departments accountable for promoting environmentally sound economic development. This means that such departments as energy, natural resources, finance, agriculture, industry, science and external affairs must take a more active role in making their policies support sustainable development.

A 1988 study for the Canadian Environmental Assessment Review Council found that "with rare exceptions, the policies of the Canadian Government are not now assessed for their environmental implications. As a result Canadian environmental policy is oriented primarily to remedying degradation after it occurs rather than to anticipating and preventing it. Many examples have shown that this is an expensive public policy."

In 1988 Marcel Masse, then energy minister, told a global conference on atmospheric protection, "From now on arguments of stronger political action... must be championed by ministers of energy as much as by ministers responsible for the environment." Mr. Mulroney subsequently promised that all government programs and projects will meet tests of sustainability. The federal environment minister has said that all projects by the federal government or on federal lands will be subject to a thorough environmental impact study.

One of the challenges to governments at all levels will be to develop and apply tests of sustainability to all their programs. There are many levers of economic power that governments can wield to steer development away from environmental damage. They can exercise influence through taxes, financial assistance, policies and regulations, agreements, research and development, export credit, regional development grants, resource development leases, marketing policies, tariffs and depreciation allowances.

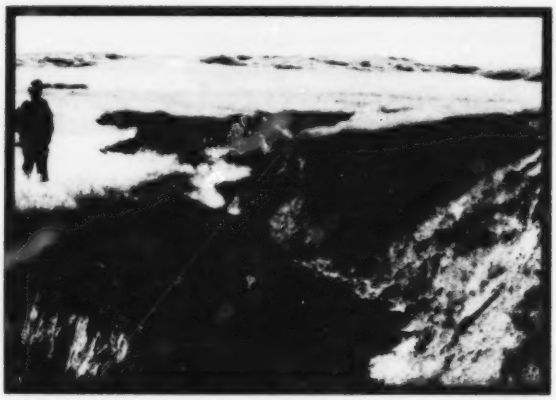
They can modify policies to:

- favour business alternatives that have the lowest impact on the environment and natural resources;
- pass laws forbidding virtually all release of persistently harmful chemicals;
- encourage and assist farmers to protect valuable farmlands from degradation. Policies based on public consultation can also give clearer direction on how much more prime farmland will be used for roads and buildings;
- require that all forests harvested (most commercial forests are on government land) are brought back to a biologically healthy state;
- draft a co-operative wilderness policy that defines how much of Canada will be left in a truly wild state and how much will be protected to the degree that wildlife and natural ecosystems can function in a state close to normal.

Business leaders are now looking to government to establish an economic climate for sustainable development. For example, Roy Aitken, executive vice-president of Inco Ltd., said that governments now stimulate certain kinds of traditional economic development, such as mining, with tax breaks. Mr. Aitken, who was vice-chairman of the National Task Force on Environment and Economy, suggested governments use similar incentives to stimulate investment in pollution controls. Ian Smyth, president of the Canadian Petroleum Association, put it candidly by saying, "Federally and provincially, Canada has plenty of sticks in its arsenal; it's time to start growing more carrots."

Governments are starting to modify programs toward sustainability. Recently a number of federal-provincial agreements have explicitly supported this concept:

- The Manitoba Agri-Food Agreement directed nearly half of its funding to soil and water conservation.
- The Prince Edward Island Forest Resource Development Agreement is aimed at preserving island forests.
- The Northwest Territories Natural Resource Development Agreement supports resource inventories and biological assessments to help sustainable resource management.
- The federal and Ontario governments are co-operating in the Soil and Water Environmental Enhancement Program which is trying to introduce better soil management and cropping practices in southwestern Ontario. This will reduce the erosion of farm fields, something which costs farmers $56 million a year and which also adds to water pollution.



Wind and water erosion take 277 million tonnes of soil from Prairie farms each year.

IMPLICATIONS FOR BUSINESS

What does sustainable development mean for business?

It clearly recognizes the need for business to keep producing the food, shelter, transportation, communications, medicines and other goods and services that are part of modern life. But the other half of the message is that many of these things will have to be done differently and some of the hazardous products and by-products will have to be eliminated. Simply put, sustainable development means that companies in the future will have to become cleaner and leaner. We have learned that not only small amounts of persistent toxic substances like dioxins but large amounts of apparently inert compounds, such as carbon dioxide, create serious environmental problems.

There is growing pressure for companies to ensure that air and water leave their properties in the same condition that they came in. To carry the message further up the pipeline it means the virtual elimination of toxic waste by-products and the sharp reduction of waste products of virtually any kind.

For many years companies have been eliminating products as society found out that they were too hazardous. There is already a long list of pesticides, including DDT and industrial chemicals and substances like PCBs and asbestos, which have been banned or severely limited in many countries. Other chemicals, including the chlorofluorocarbons that destroy the ozone layer, are on their way out.

One of the greatest challenges ahead for business is to find ways of ensuring that products and by-products that appear safe at first do not have some tremendous hidden environmental cost.

What is there for business in return for such major shifts?

Avoiding the costs of decisions that have bad environmental impacts is becoming a powerful motivating factor for change. One big company after another has seen its products suddenly pulled from the shelves because they were found to be harmful. Another motivation is the avoidance of multi-million-dollar clean-up

costs, rising insurance premiums and government regulation.

Governments are being pressured by public opinion to get more involved in business practices both by writing more regulations and by creating environmental police forces and increasing anti-pollution penalties. In the past, fines for pollution were usually so small as to be considered a licence to pollute. Now, governments are passing laws that carry big fines and even jail terms for corporate executives and government officials who allow pollution.

There is also a reward for being clean and efficient. If we start moving now, Canada can write an economic success story that will last long into the future. We will have businesses which are much more energy-efficient and harvest more marketable product from less raw material. They will be clean businesses that use low-toxicity materials and keep their waste products within the factory gates to be recycled into more products or to be neutralized.

As part of their clean-up programs, many companies are already installing new equipment that is much more efficient. For example, a project to modernize pulp and paper mills in Ontario, Quebec and the Atlantic provinces resulted in a 20-per-cent reduction in wood use and about a 30-per-cent cut in pollution levels for the industry as a whole between 1980 and 1984. Their energy purchases dropped by 30 per cent between 1972 and 1984 despite increased production.

Some companies are reducing the amount of acid gas they release by making their old smelters both cleaner and more productive, thus making themselves more competitive in the marketplace.

Mr. MacNeill, formerly of the Brundtland Commission, says that nations which become energy-efficient will be more competitive. He notes that between 1973 and 1984, Japan cut its use of energy and raw material per unit of industrial production by 40 per cent. Mr. MacNeill feels this helped Japan move to the number two spot in global economic performance during the same period.

Sustainable development means a cleaner environment, adequate resources for future generations and jobs. In an indirect sense all jobs rely on a healthy environment. In a direct sense many Canadians depend on the environment or environmental protection for work. For example, environmental industries in Canada employ about 100,000 people directly and another 50,000 indirectly. Three thousand Canadian companies work in environment-related fields such as remote sensing, geographic information systems, resource and environmental planning, environmental data processing and modelling, chemical analyses, waste disposal, water and air cleaning. In addition, there are environment departments or units in all senior governments and many businesses.

The list of environmental businesses is rapidly growing as companies are created or expand to produce anti-pollution, recycling and waste-removal equipment. Those businesses that develop the most sustainable techniques and technologies can expect to be successful in the marketplace, some of them on a world scale.

We can already look at some forms of business as sustainable. Recycling operations, clean industries, small-scale forestry and organic agriculture come to mind. Some of these operations can be increased in scale to cope with large markets.

A number of major Canadian businesses are recognizing the need to lessen their impact on the environment. For example, executives of five major corporations and two big business associations signed the National Task Force Report calling for big changes by business. Some business groups have adopted codes either requiring or encouraging member companies to protect the environment during their work.

An example is the Environmental Code of Practice adopted by the Canadian Petroleum Association. It tells the 65 member companies, which are in exploration, production or pipelining of oil and natural gas that "they must incorporate environmental planning into their decision-making process and use the best practical technology to minimize the impacts of their operations on the environment and on public health and safety."

Canada's chemical industry has been under fire in recent years, and in 1987 the Canadian Chemical Producers Association announced a responsible care policy with seven codes of practice. These include working with communities to develop emergency plans to deal with chemical accidents, and developing a community right-to-know policy, which would inform citizens about chemicals in their local industries.

A spokesman for the association said that industry also has a role to play in cleaning up old chemical dumps across the country and supports a broad tax to help with the job. Some industry leaders say that in order to speed up

change they will have to share pollution control expertise with firms that are not able to do the job on time on their own.

In 1988 a group of farm chemical companies called the Crop Protection Institute of Canada released a booklet encouraging farmers to reduce excessive chemical use. The companies say they want to cut in half the amount of pesticide that washes off farm fields in the next decade.

One of the most important things that business in general can do is to develop a broad environmental ethic and code of practice. A good code of conduct would reduce environmental problems and result in less need for government regulation along with the threat of fines and jail terms for company employees.

The National Task Force, citing the International Chamber of Commerce, said: "Companies which have an impact on the environment should provide their boards of directors with annual reviews on environmental performance and the implementation of their environmental principles and policies, in order to ensure that those responsible for corporate direction are fully informed." In 1988 the National Survival Institute did a survey of annual reports and found that only 37 of 61 had references to environmental impact. The environment group wants companies to make environmental impact part of their annual reports to their shareholders.

Empty herbicide barrels on a farm pose a waste disposal problem.

IMPLICATIONS FOR PUBLIC INTEREST GROUPS

Over the years some of the strongest environmental leadership has come from public interest groups. They have kept alive the flame of interest and concern even when governments, business and the public at large showed little concern. Such groups have kept up a steady flow of information on the environment to the news media and the public. Some even mounted their own projects, such as recycling, home insulation and the detection of toxic substances.

In the past the situation seemed simple. There were polluters and there were environmentalists. Often the environment groups felt that they faced only businesses that polluted and governments that were slow to regulate. Now they face a complex playing field in which there are still polluting companies and lax governments, but there is an increasing number of environmentally conscious business people and cabinet ministers.

One of the great challenges for the environment movement will be to retain a position of social critic to prod the reluctant into action and provide an independent voice, while co-operating with businesses willing to change. Already some environment groups have made participation in the debate for sustainable development a high priority, while others prefer to remain as watchdogs.

IMPLICATIONS FOR EDUCATION

Environmental education must change if we are to stop producing one generation of polluters after another. While this generation will have to shoulder the responsibility for launching major changes, today's youth will soon be part of the effort.

The Brundtland Report said, "Education should provide comprehensive knowledge... cutting across the social and natural sciences and humanities... providing insights on the interaction between natural and human resources, between development and environment." It needs to "foster a sense of responsibility for the state of the environment and to teach students how to monitor, protect and improve it."

The report said that the attitudes of teachers will be critical, and suggested that specialized training will be needed so that teachers will be able to explain the current situation and the kind of change needed in the future. It will be vital to enlist the willing help of top education officials, some of whom regard environmental education as yet another special-interest subject to be squeezed into the curriculum. But education about sustainable development implies something far deeper. Canada's National Task Force said the nation's environment and education ministers should co-operate to upgrade environmental education substantially. It said that environmental economics and the concept of sustainable economic development should be incorporated into high school and undergraduate studies.

IMPLICATIONS FOR INDIVIDUAL BEHAVIOUR

While big government and big business are often seen as the key actors in bringing change, the individual citizen has the most important role of all.

Governments and companies are made up of individuals and are guided by their decisions. If people become informed about problems and solutions, they can start finding ways to introduce change within the biggest organizations.

People are now bombarded with information about problems, but there is a dearth of public information about solutions. As a result many citizens take the attitude that there is little they can do to save the environment, instead of realizing that the problems will be solved only by myriad individual actions.

At the home front each individual's contribution to pollution control and energy reduction is small in isolation. But when you multiply the number of individuals the effect is immense.

Most households have enough chemicals in them to start a small but lethal laboratory. These include: paints and paint thinners, insect and weed killers, anti-freeze, chlorine bleach, nail polish, oven cleaners, mildew removers, rust dissolvers and a dozen other household products, many labelled as poisonous, corrosive or explosive. Some of them, such as toilet bowl and drain cleaners, are deliberately poured into the water system, often in far greater amounts than are really needed. The green lawn syndrome has led homeowners to pour herbicides and chemical fertilizers on their lawns. Part of that chemical load is washed off into the sewers and then into the lakes from which we drink.

When we are finished painting, the wastes usually go down the drain or into garbage dumps, which slowly leak. Partly empty cans of insect sprays, mercury and cadmium batteries, radioactive smoke detectors and hundreds of other materials go into municipal landfill dumps where they pose a long-term hazard of leakage. If burned in municipal incinerators they become an air pollution problem. Each consumer of hazardous products is also responsible for a share of the wastes which flow from the factories where the products are made.

Many changes can be made immediately in the home. You can eliminate or reduce the use of products labelled poisonous, corrosive, explosive or highly flammable. If you must use such products, do not dispose of them down the drain. Give away the unused portion to someone who can use the material or ask the municipal government for the location of a safe disposal site or dropoff point.

Switch to less toxic substances. Such old-fashioned cleansers as vinegar and baking soda are still effective and are relatively inert. Insecticidal soaps and "natural" insecticides pose less risk to food plants and to beneficial insects than do many synthetic chemicals.

Water-based paints are less toxic than those which use petroleum solvents. Avoid the use of aerosol cans, particularly for hazardous products, because some of the product goes into the air you breathe.

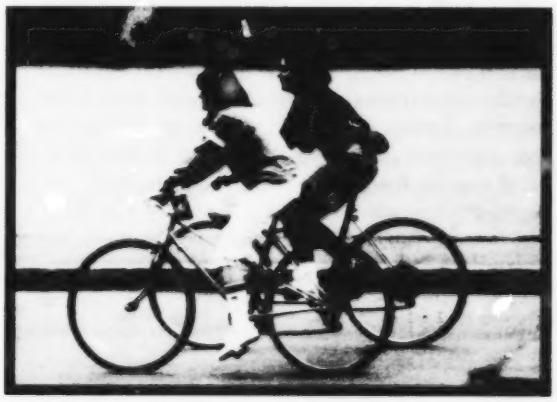
We can look for ways to save energy and resources at home. Each litre of water from the tap has to be chlorinated and pumped, and that takes chemicals and energy. Every litre of gasoline burned puts more pollution into the air and reduces non-renewable resources. If your municipality has recycling, use it and push for more materials to be covered in an effort to reach the highest level possible – probably 70 per cent or more of household waste. If there is no recycling program, encourage and help the politicians to start one. Start composting garden and some food wastes in your backyard rather than putting them into the garbage and helping to fill up dumps.

Buy durable goods rather than disposable ones wherever feasible. A high-quality product will likely cost more to buy, but can last for years, even centuries, and will look good and function well for a long time. Each time that disposable or poorly made goods have to be replaced this requires more energy and raw materials. Public information on pollution control and energy efficiency is available free from electric power commissions, environment groups and government offices responsible for energy and environment.

As public pressure for "environmentally friendly" products mounts, the marketplace is starting to respond. Companies have been rushing to remove chlorofluorocarbons from most aerosol cans and foam plastics, and to produce biodegradable packing. Organic food is starting to appear on more supermarket shelves. Tony Wilshaw, president of the Canadian Federation of Independent Grocers, said in 1988: "The whole food industry... will do everything it can to promote responsible environmental products ... right through to the household level to promote recycling." In provinces such as Ontario, companies that produce and use metal beverage cans are contributing to programs to help recycle empty containers.

Surveys have shown that four out of five Canadians will pay up to 10 per cent extra for goods that have a low environmental impact, but people have trouble identifying such products. Environment Canada has launched a program called Environmental Choice to help consumers identify products which ease the pressure on our environment. Selected products will be marked with a distinctive logo issued by the Canadian Standards Association based on advice from an independent panel. The federal government added support to the program by saying that it would favour such products in its purchasing.

In the future the challenge will be to expand the list of environmentally friendly products to include the ones that have the lowest total environmental impact. This will include counting the types of materials used in their manufacture, the amount of energy required to make and transport them and the waste products created along the way.



DEALING WITH THE REST OF THE WORLD

In its 1987 policy on environment and development, the Canadian International Development Agency (CIDA) said: "The world's poorest countries are facing an environmental crisis of unprecedented dimensions. In many regions soils are being washed away, forests are disappearing, deserts are spreading, genetic and wildlife resources are in jeopardy and water resources are threatened. Most of the resources under stress today are vital to the long-term economic growth of these countries."

In the past, Canadians have been sympathetic to the plight of poorer nations and have sent assistance, but somehow their problems seemed remote from our lives. Now we are beginning to understand that not only is there a humanitarian issue of gigantic proportions, but that we have an increasingly direct interest in what happens overseas. Decisions in other lands will affect our air and the resources we depend on.

To achieve sustainable policies Canada's provincial and regional plans will have to mesh in a national approach and this in turn will have to become part of an international co-operative effort. It will require complex changes. Billions of people aspire to the kind of life now enjoyed by the rich countries, but if they duplicate our style of development the biosphere will be grossly damaged and all will suffer. But they are unlikely to want to remain in poverty while a few continue to enjoy all the comforts. So the difficult task ahead is to see that the inevitable development of the Third World is sustainable. It will not be an easy task but there are obvious starting points.

One of the first tasks is to relieve the crushing burden of foreign debt that forces many countries to strip their natural resources just to meet interest payments. As of early 1989 the debt was $1.3 trillion (U.S.) and rising. Many countries are clearly unable to pay it off and are being forced into fiscal and environmental bankruptcy.

During the 1988 Economic Summit in Toronto, West German Chancellor Helmut Kohl urged industrialized nations to forgive some of the debt of Third World countries if they protect their rain forests in return. This is often referred to as "debt-for-nature swapping."

Countries are unilaterally writing off some foreign debts. In 1987 Canada forgave $670 million in development-assistance debt to some of the poorest nations of Africa. There are suggestions that payment of much more foreign debt will have to be forgiven or postponed for many years because there is little hope that many poor countries can repay all their debts.

Another step toward sustainable Third World development is the transfer of the cleanest and most efficient technology to minimize the environmental impact of those countries' development. Such moves would have to be part of a global trading agreement to avoid sudden dislocations in the world economic system.

The governments and industries of developed nations must take responsibility for business actions overseas. There has been a series of scandals in recent years over the dumping of hazardous wastes from industrial nations into poor countries which have no capacity to analyze, let alone handle, such materials. There are growing calls for industrial nations not to export either wastes or hazardous products that are not allowed at home. Environmentalists also say that rich countries should not support economic policies that lead to the destruction of tropical rain forests or desertification of poor nations.

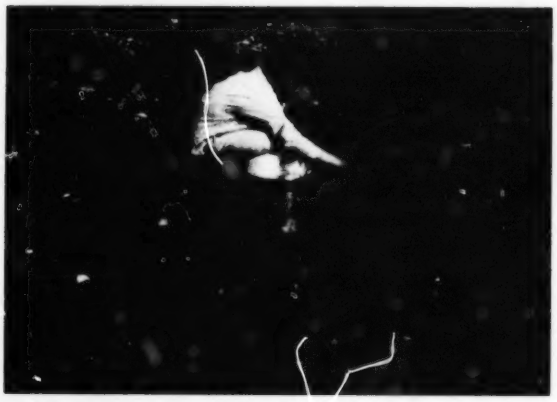
The Dutch government has proposed that developed nations should help poorer countries do environmental audits of development proposals. Teams of experts would travel around the world to help examine business proposals to make certain that they were sustainable.

Canada's foreign aid has been revised in light of such ideas. CIDA, which supported the Brundtland Commission with $1 million in assistance, issued new environmental guidelines

on the day the Brundtland Report was released in Canada. It promised environmental impact assessments of all projects financed by CIDA and more emphasis on projects that protect or rehabilitate the environment.

The World Bank, which lent nearly $20 billion to poor nations in 1987, has financed development projects that ended up destroying the environment. Barber Conable, president of the Washington-based bank, said that environmental considerations will be integrated into all of the bank's lending and policies to avoid more mistakes in the future.

There are questions as to whether current levels of assistance to developing nations are adequate. In 1988 Tom McMillan, then Canada's environment minister, suggested that the industrialized world needs to focus massive resources on Third World problems. He said, "Just as the Marshall Plan rebuilt the war-shattered economies of Europe, so also we need a global plan to rebuild the debt-shattered economies of the less developed nations."



Drawing water from a primitive well

International agreements will be another tool in the building of sustainable development. We can build on existing agreements that already ban atmospheric nuclear weapons tests, restrict nuclear arms and control the transboundary flow of pollution.

One of the oldest such agreements is the 1909 Boundary Waters Treaty between Canada and the United States. It codified the principle that no nation has the right to pollute another with the phrase: "Boundary waters and waters flowing across the boundary shall not be polluted on either side to the injury of health or property on the other." Under this treaty the two nations have signed a number of specific agreements and have spent billions of dollars to control the kinds of pollution that were choking Lake Erie with green slime. More recent agreements are controlling the release of toxic chemicals into the Great Lakes.

There is a growing list of agreements on the control of international air pollution. The 1979 Geneva Convention on Long-range Transboundary Air Pollution pledged 35 nations not to export their air pollution problems. In 1980 Canada and the United States signed a Memorandum of Intent to reduce transboundary air pollution, an agreement that remains to be implemented. The 1985 Vienna Convention for the Protection of the Ozone Layer and the 1987 Montreal Protocol to that agreement require signatory nations to reduce by half the use of the principal ozone-destroying chemicals by 1999.

Sustainable development is closely linked with the arms race in at least two ways. First, nuclear war poses the greatest environmental threat of all. Second, the arms race consumes $1 trillion a year, draining resources which could be used to provide food, clean water, sanitation and housing for the poor of the world. The Science Council of Canada noted that it would cost about $20 billion a year to provide everyone on earth with safe drinking water and sanitation. That is four per cent of the arms budget.

The efforts to reduce world tension and the arms race are an extremely important part of a sustainable development strategy, for they will free up money and human energies to tackle the environmental threats. Canada has long been active in the military peacekeeping efforts that won the 1988 Nobel Peace Prize. This country is also a leader in negotiating international agreements to protect the environment. There is now an opportunity to show leadership in finding sustainable forms of development.

International co-operation will come only through better understanding of what needs to be done. The federal and Manitoba governments have launched an international centre for sustainable development. The centre, located in Winnipeg, will work with United Nations and other international groups to help people share information about the global environmental issues and their links with economic development. A growing number of conferences on sustainable development are being organized by government, business and environmental groups. A major national conference is to be held in 1990 and a global meeting in 1992.

POPULATION

If Canada and the world are going to deal with root causes of global environmental problems, they must come to grips with population growth, one of the most contentious issues.

The planet is in the midst of a population explosion that will push human numbers from over 5 billion now to over 6 billion by the year 2000 and as high as 10 billion by the middle of the next century. Most of that increase will be in the developing world. The Brundtland Report says the world must fight poverty if it wants to limit population growth. "Poverty breeds high rates of population growth," the report states, noting that poor families need more children to bring in money and to sustain parents when they get too old to work.

By providing social security, better public health and child nutrition programs that reduce infant mortality rates, a nation can encourage people to have fewer children. If women are encouraged to start careers and to marry later in life, they are less likely to raise large families. Taxation policies, including child-care deductions, can either encourage or discourage larger families.

The "population problem" is more than a simple head count. The 26 per cent of the population living in the developed world consumes 80 per cent of commercially produced energy, 79 to 86 per cent of the metals and up to 34 per cent of the food. Since Canadians are among the world's heaviest consumers of energy and products, our impact on the biosphere is greater than that of a country with a much larger population. Donald Chant, a member of the National Task Force, has said that Canada probably has the biospheric impact of a country the size of India or China.

THE FUTURE

We are at a historic crossroads. Many of the trends that made our society so affluent and so comfortable are peaking because of pollution and the depletion of cheap, easily available natural resources.

In the long term we know what we want: a clean, green world which runs efficiently and provides us with our needs. What we need to write is a better set of directions about how to move in that direction. It is not yet clear just how far we will have to go in our changes. It is obvious that products that waste energy and resources will either have to be reduced sharply in number or made much more cleanly and with less raw material.

The Brundtland Report called for lifestyles that are "within the planet's ecological means." When asked if humans can make that kind of shift quickly enough, Maurice Strong said, "It is going to be a race between our sense of survival and our more indulgent drives."

In 1988, Javier Pérez de Cuéllar, secretary-general of the United Nations, said: "Decision makers must be made responsible for the environmental consequences of their decisions." And he called for "a comprehensive monitoring and evaluation system" to alert people everywhere to the need for change.

Developing a sustainable society requires more than a dry set of instructions. It must include the goals and aspirations that people want for that society. Theologian Thomas Berry says that western civilization has lost the sense of what it wants the world to be, so we have to build a new set of goals. A century ago Canada had a national dream to unite the country physically with a railroad. Now we need a new national dream of a secure future for Canadians in a healthy environment. If it is to be successful this must be part of an international movement with links in every country.

The stakes are high enough. As British author William Golding, winner of a Nobel Prize for Literature, said: "It is the only planet we have got, after all."

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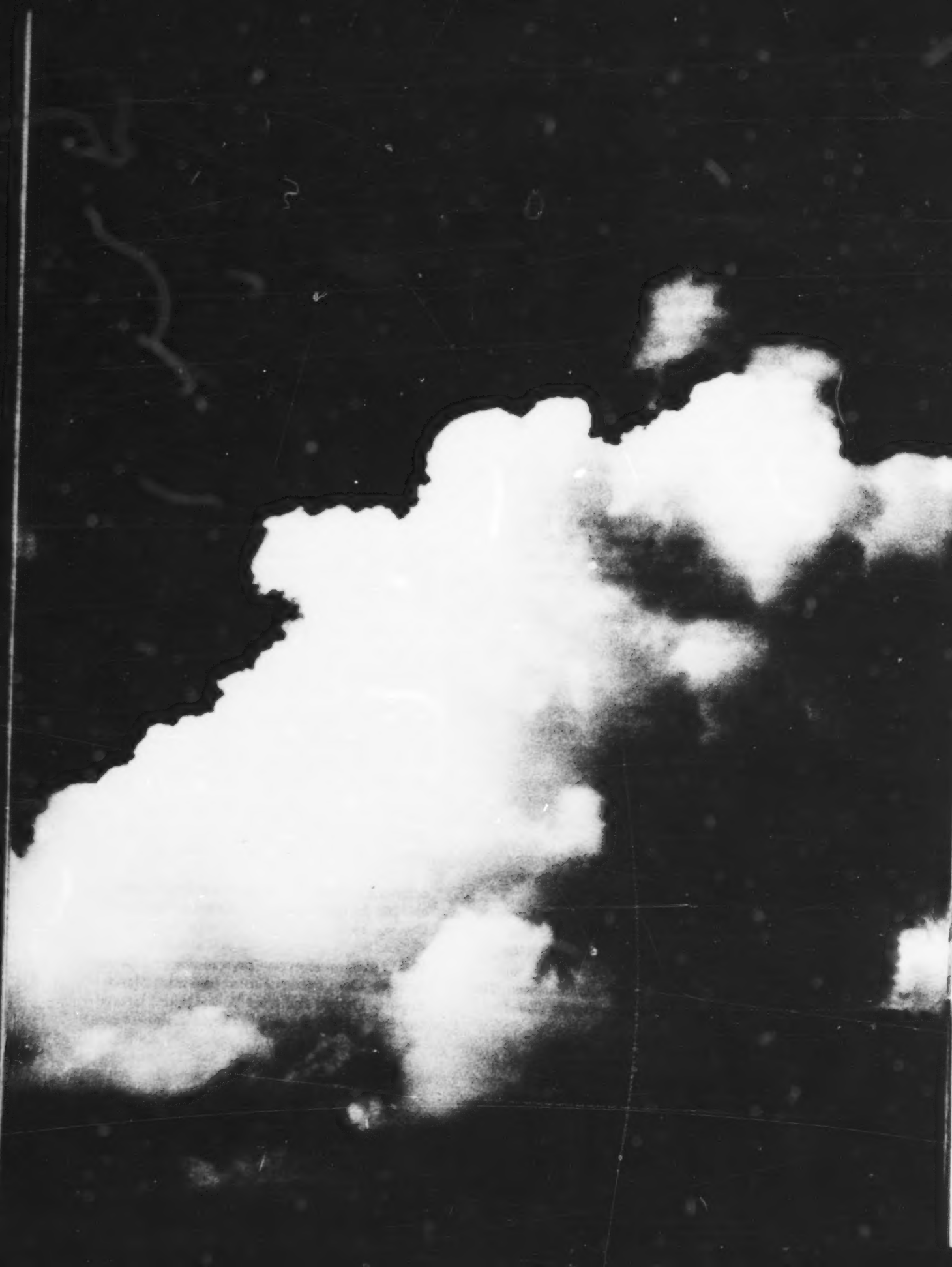

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